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Front cover: *Ploughing paddy in Sri Lanka (photo: Land Technology Ltd).*

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Factors influencing the performance of animal drawn road rollers

Michael J Hann & Simon R B Done

Abstract

Labour based methods have an important role to play in road construction and maintenance in developing countries. Compaction is an essential component of road making but labour based compaction is handicapped by a lack of standards and practical guidelines. A systematic study of compaction by appropriate lightweight equipment should help in a wider acceptance of labour based compaction.

Blocked experiments were conducted in the controlled conditions of the Silsoe College soil bin with the aim of evaluating the performance of animal drawn road rollers.

Investigations considered the influence of roller weight, soil layer thickness and the number of roller passes per layer on the resulting compaction of a sandy loam soil. Rollers were fabricated from oil drums and ballasted to 150, 300 and 600 kg/m width of roller. Layer thickness varied from 25 mm to 100 mm and roller passes ranged between 1 and 12. Increasing roller weight, reducing soil layer thickness and introducing a greater number of passes all increase compaction performance.

Eight passes were found to be optimum for all roller weights. A performance chart based on 8 passes has been developed to enable a selection of weight/layer thickness to be made which will achieve a given relative compaction level. It was shown that the selected combination can be operated by 1 animal (or 4 people) provided roller width is limited.

Penetration resistance was found to be a useful guide to compaction performance although a direct relationship could not be established.

This manuscript was first submitted on 9th April 1997 and accepted in revised form on 9th January 1998 for publication as a refereed paper.

Dr Michael J Hann is Lecturer in Agricultural Engineering and supervised Simon R B Done's project as part of the MSc programme at Silsoe College, Cranfield University, Silsoe, Bedford MK45 4DT.

Introduction

Labour based methods of construction offer many benefits to developing countries particularly for construction in rural areas (Howe and Richards, 1984). Employment is provided, the local economy grows, skills can be learnt which ensure long term road maintenance or lead to further work, use is made of abundant resources without reliance on scarce or costly machinery and the development of a base of small road contractors, or subcontracting of road maintenance to locally resident lengthmen becomes possible (Andersson, 1993). In many cases, reliance on machinery can be reduced and, in certain instances, the need for powered machinery is avoided.

Compaction is an essential part of road construction whether it is carried out during construction or afterwards by the passage of traffic. Often the only powered machine on a labour based road site is a pedestrian vibrating compaction roller. Smaller contractors or lengthmen, are unable to run this equipment due to mechanical failures and/or fuel shortages (Hlaing, 1992).

Investigations have been conducted into the scope of animal/human powered equipment. Hand rammers have proved to be slow and non-uniform and therefore unsuitable for roads of any significant length (Kyulule, 1984). Various studies have been undertaken in Asia and Africa to evaluate the performance of animal or human drawn rollers, (Beusch, 1992; Bindra *et al.*, 1980; Lehobo, 1993). Although of considerable value individually these studies have been carried out independently and are hence not systematic or comparable.

Guidelines similar to those available to heavy mechanised plant operators (I.C.E., 1981) are not at present available to labour based contractors or lengthmen.

This paper presents the results of research carried out in controlled conditions on an animal drawn smooth roller. The aim of the investigation was to evaluate the influence of (i) roller weight, (ii) thickness of compacted layer and (iii) number of passes, on the level of compaction achieved and the draught requirement.

Experimental method

The experimental work was conducted under controlled conditions in the Silsoe College soil bin. The sandy loam soil was maintained at a gravimetric moisture content of 11%, this being the Proctor test value for the optimum compaction. The rollers were fabricated from oil drums which gave a working width and diameter of 880 mm and 580 mm, respectively

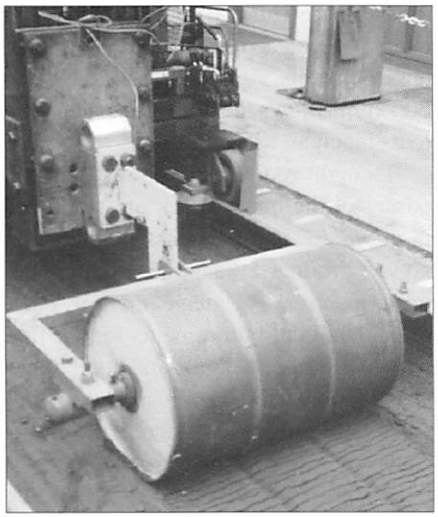

Fig. 1 Fabricated roller operating in the soil bin.

(Figure 1). Earlier work by the author (Hann & Heather, 1992) has shown that varying the roller diameter will have an influence on performance. It was however decided to concentrate on one diameter which, in the form of an oil drum, provides a readily available source appropriate to rural manufacture and would not develop excessive draught. The final ballast weight was aimed at producing a roller draught suitable for four people or two animal operation.

A randomised complete block layout with 3 replications was used in the study. A forward speed of 0.25 m/s was maintained simulating a slow walking speed. For each treatment, layers of soil were spread and rolled until a compact depth of at least 225 mm was formed.

Two roller weights, three layer thicknesses (25, 50 and 75 mm) with either 2, 4 or 8 passes were considered in the main study. The roller weights were achieved by filling the oil drums with water (264 kg, 300 kg/m) or gravel (528 kg, 600 kg/m). Further tests with a thicker layer (100 mm), more passes (12) and a lighter roller (132 kg, 150 kg/m) were also conducted.

The draught force required to pull the roller was measured using an extended octagonal ring transducer (Godwin, 1975). Dry density and penetration resistance measurements were taken to assess the compaction performance of the roller. Measurements were made at various depths through the compacted profile using sampling rings and a penetrometer, respectively.

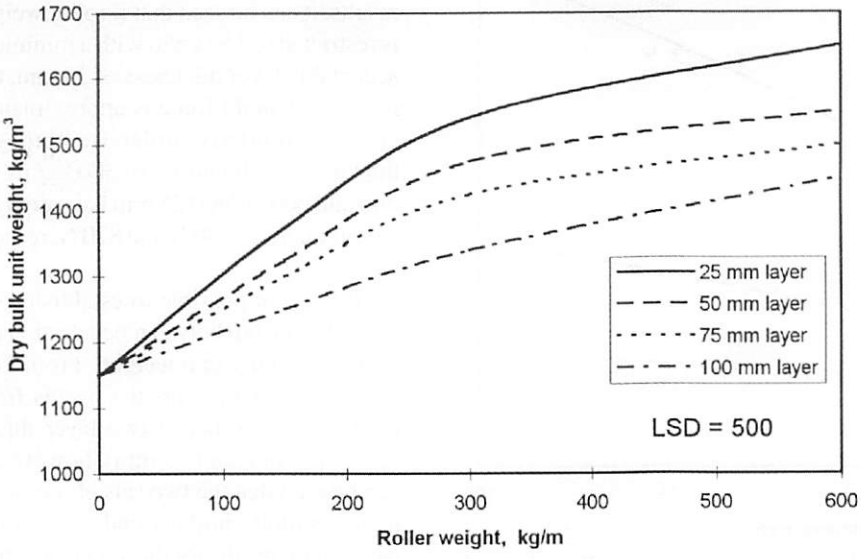

Fig. 2 The effect of roller weight and layer thickness on the dry bulk unit weight of sandy loam soil after eight passes.

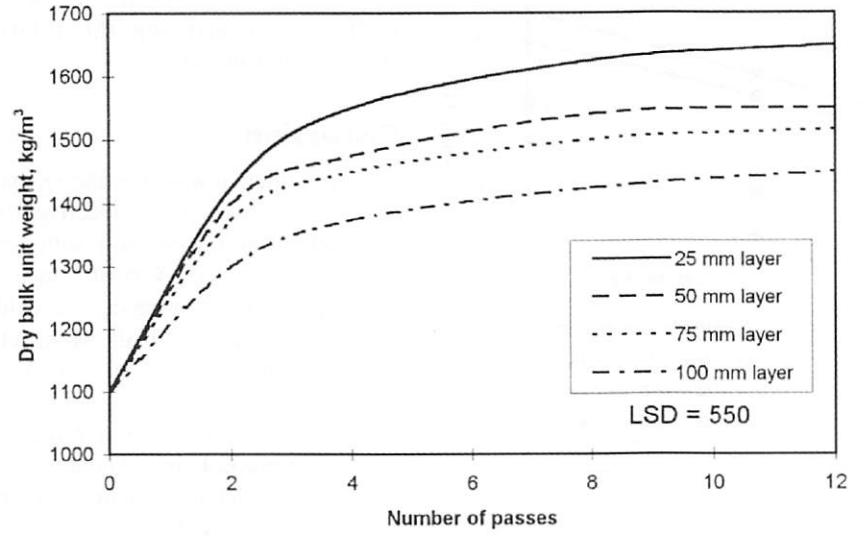

Fig. 3 Relationship between the number of passes and the dry bulk unit weight of a sandy loam soil (600 kg/m roller).

Results

The influences of roller weight, number of passes and soil layer thickness on the compaction achieved are presented in *Figures 2 and 3*. Compaction is expressed as the final dry bulk unit weight of the soil: the maximum dry bulk unit weight as measured in the standard Proctor test was 1810 kg/m^3 for the sandy loam soil used in the experiment.

Generally, there is an improvement in compaction performance with a heavier roller, more passes and thinner soil layers.

The figures show that increasing roller weight produces a significant increase in compaction performance for all layer thicknesses. It is also clear that greater weight has more effect on total compaction as the depth of layers increase. Reducing the layer thickness improves the compaction as does increasing the number of roller passes. This enhancement, however, was not significant beyond 8 passes.

Figure 4 presents the roller output following 8 passes in terms of relative compaction. Relative compaction is the ratio of measured and maximum (standard Proctor test) dry bulk unit weight achieved (TRRL, 1952). An appropriate level of compaction for rural roads is in some doubt (Stiedl, 1994): in this study, relative compaction levels between 75 and 80% have been deemed satisfactory. The results suggest that a roller weighing as little as 150 kg/m is only likely to be acceptable in sandy soil if the layer thickness is restricted to less than 30 mm. In-

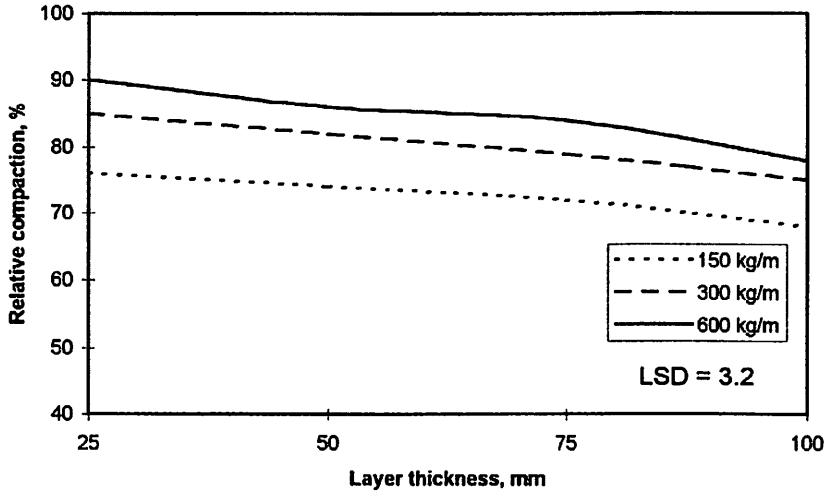

Fig. 4 The effect of roller weight and layer thickness on the relative compaction of a sandy loam soil after eight passes.

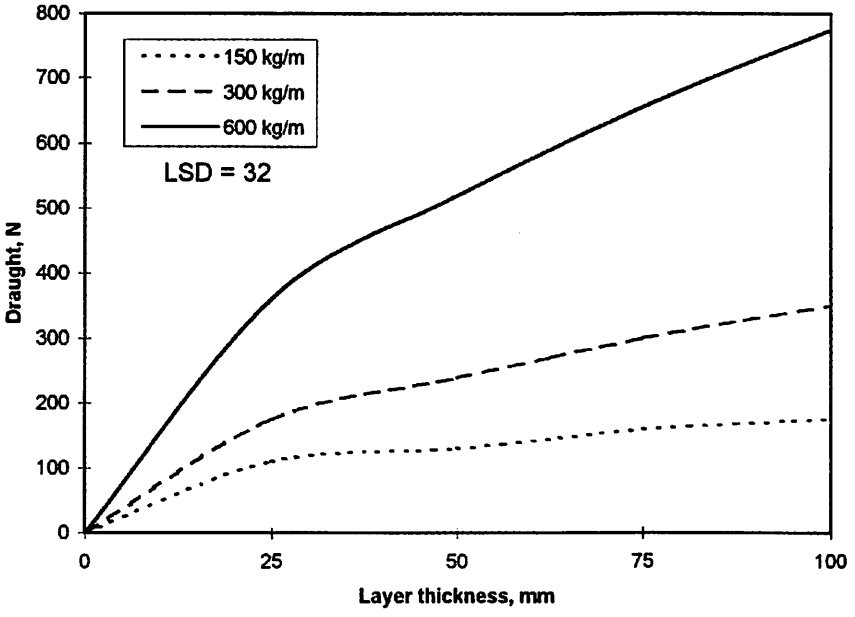

Fig. 5 The effect of roller weight and layer thickness on roller draught requirement (first pass, sandy loam soil).

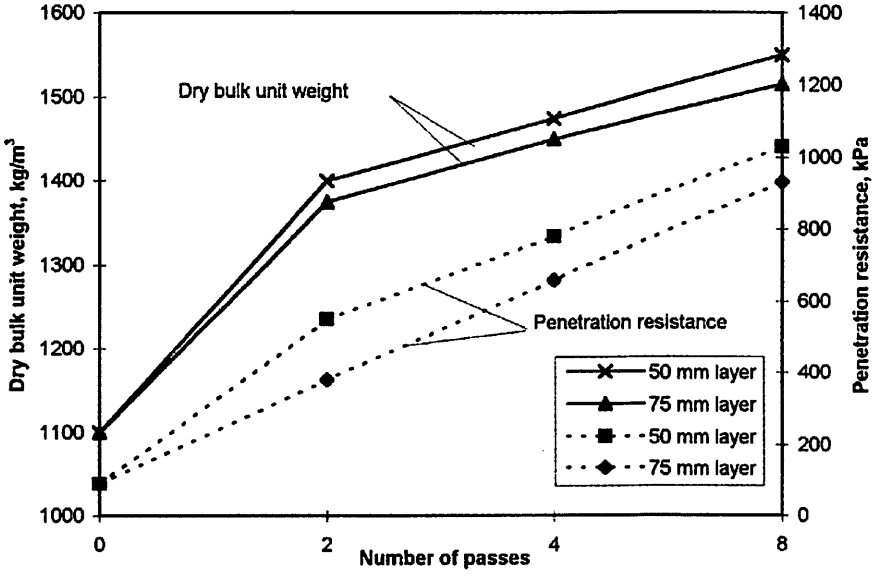

Fig. 6 The relationship between dry bulk unit weight and penetration resistance as a measurement of soil compaction performance (600 kg/m roller).

creasing the roller weight to 300 kg/m extends the acceptable depth of layer to approximately 90 mm. A further rise to 600 kg/m allows the thickness to increase to as much as 125 mm.

Draught requirements for the first 3 passes of the heavy roller are presented in *Table 1*. The first pass of the roller always produced the highest draught being as much as 30% greater than any other pass. Draught requirements for the first pass of all roller weights and layer thicknesses considered are illustrated in *Figure 5*. Roller draught increases significantly with a rise in weight and layer thickness. This would be expected due to the enlarged 'bow wave' resulting from greater sinkage increasing the rolling resistance.

From the earlier relative compaction results, it can be seen that if roller weight is restricted to 150 kg/m with a minimum acceptable layer thickness of 30 mm, the required draught force is approximately 105 N. Similarly, roller weight/layer thickness combinations of 300 kg/m / 90 mm and 600 kg/m /125 mm have draught requirements of 340 N and 870 N, respectively.

It was not possible to establish a direct relationship between penetration resistance and dry unit weight. From *Figure 6* which represents the results from the 600 kg/m roller at two layer thicknesses (50 mm and 75 mm), however, it can be seen that the two sets of measurements exhibit similar trends, providing penetration results for the top twenty-five percent of the compacted depth are discarded. As the penetrometer readings were also found to be consistent over depth, it can be considered a useful method of measuring the relative compaction achieved.

Discussion

The experimental work has shown that it is possible to produce effective road compaction on a sandy soil with small animal drawn rollers. Very little increase in compaction performance was exhibited beyond 8 passes of the compactor. It is recommended therefore that this number be adopted for road work.

In order to achieve the required degree of compaction, an acceptable roller weight/layer thickness combination must be selected. *Figure 7* illustrates the combinations of roller weight and compacted layer thickness required to obtain relative compactions of 75, 80 and 85% (this be-

Table 1 Draught requirement for the first 3 passes of a 600 kg/m roller.

No. of passes	*Draught, N, for different compacted layer thicknesses*			
	25 mm	*50 mm*	*75 mm*	*100 mm*
1	361	477	657	775
2	318	390	499	582
3	275	303	342	385

ing the normal range considered for rural road compaction).

Although 25 mm layers were considered within the trial, it is unlikely that such a limited depth would be practicable. Stony soils will be difficult to spread or roll in such thin layers, the control of road level will be difficult and the use of such thin layers may lead to unacceptably low productivity. For these reasons it is likely that the minimum practical thickness adopted will be approximately 50 mm. Results from *Figure 7* suggest that, at this thickness, the weight required to achieve relative compactions of 75, 80 or 85% will be 175 kg/m, 255 kg/m or 500 kg/m, respectively. Other combinations up to a roller weight of 600 kg/m and soil layer thickness of 125 mm can be interpolated from the graph.

Values of the draught capacity of animals are presented in *Table 2*. and show that one animal (or 4 people) should produce a draught force of approximately 400 N. This is sufficient to pull a 500 kg/m equivalent weight oil drum roller over a 50 mm soil layer and hence achieve the range of relative compactions required.

For greater layer thicknesses it will be necessary to either:

i) increase the number of animals/people or,

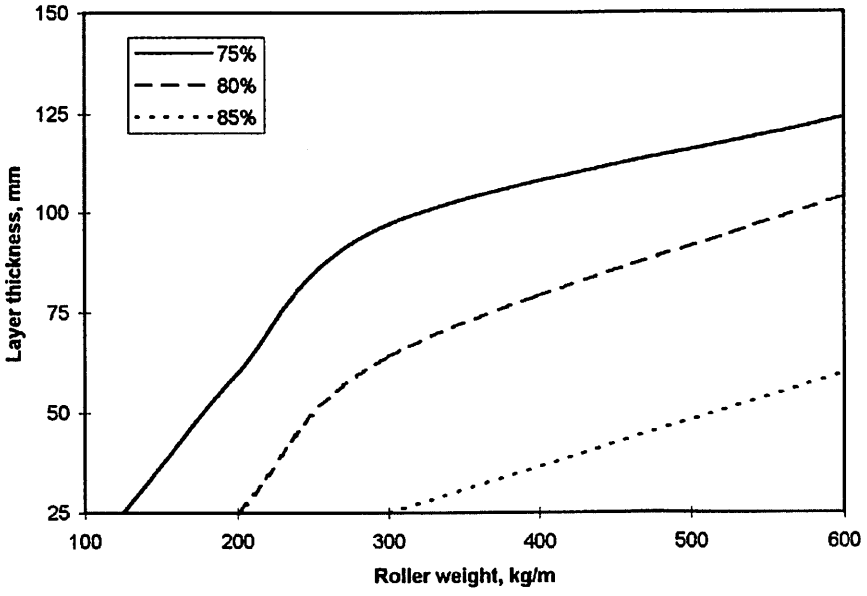

Fig. 7 The influence of roller weight and layer thickness on the relative compaction (%).

ii) reduce the width of the roller whilst maintaining the relative weight.

The first alternative will increase the available draught force so that any roller/layer combination can be selected to produce the required relative compaction. The second will reduce the draught requirement to an acceptable level, whilst retaining the compaction performance. (Halving the width of the drum whilst maintaining a relative weight of 600 kg/m allows a single animal - or 4 people - to roll 100 mm layers and achieve the range of relative compactions desired.)

The drums employed for the experimental work proved to lack robustness indicating that they would have a limited field life. It would, therefore, be necessary to either reinforce the drum or fabricate rollers with improved strength characteristics. In one instance the drum casing became ribbed, this arrangement exhibiting an improvement in local compaction performance. This suggests that the addition of ribbing to the roller surface may both improve performance and provide enhanced life.

Table 2 Draught capacity of typical animals (Crossley and Kilgour, 1983).

Type	*Draught capacity, N*
Human	100
Donkey	300
Mule	450
Horse	550
Buffalo	650

Conclusions

The work has shown that an increase in weight, a greater number of roller passes and a reduction in compacted layer thickness significantly improved the compaction performance of labour based road rollers on sandy soils. Eight passes were found to be an optimum, further passes producing no significant improvement in performance.

A performance chart has been developed for the range of roller weights and soil layer thicknesses considered within the study. Using the chart it is possible to select combinations of weight/layer thickness to achieve a given relative compaction level between 75 and 85%.

The draught required by any of the above combinations can be provided by one animal (or 4 people), provided the roller is not more than 0.5 m wide.

Increasing the available pulling power to two animals (approx. 8 people) provides the opportunity to improve the roller performance in terms of both compaction level and rate of work achieved.

Developing a roller with a ribbed drum surface should improve both its life and compaction capability.

The compaction achieved on labour based road construction can be checked using a penetrometer provided it is used comparatively and ignores the first 25% of the overall compacted depth.

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Farm income recovery in sight

Farm incomes will reach their lowest point in 1998 before recovery takes hold during 1999 according to the latest economic predictions from Barclays Agricultural Services.

UK net farm income levels are expected to drop to £1.7 billion in 1998 from £2.3 billion in 1997, and a recent peak of £4.2 billion in 1995. However, 1999 should see the beginning of a slow but steady recovery with incomes increasing by 12 per cent to £1.9 billion in 1999, and by a further 24 per cent to £2.35 billion in the year 2000.

The downward trend in farm incomes will continue in 1998 due to: little change in the current high value of sterling as uncertainty about the strength of the euro results in the continuing weakness of European currencies in the lead up to European Monetary Union; a weak world grain price as grain production continues to outstrip consumption; low milk prices of around 20 pence a litre; and the freezing of EU support payments to UK farmers.

Barclays forecasts suggest that these problems should diminish over the coming year, making 1998 the bottom of the economic cycle for the agriculture sector, and allowing farm incomes to rise steadily in 1999 before increasing more strongly in the year 2000.

John Page, head of Barclays Agricultural Services said: "The upward trend in farm incomes will be helped by a series of changes in economic conditions. The newly established euro should begin to gain strength against sterling early in 1999 as fact replaces uncertainty about the way the European Central Bank will manage the new currency. This will increase the value of existing EU support payments to British farmers and make their produce more competitive in the market place.

"We also expect consumption of grains to increase to production levels and beyond, which should be reflected in increased world cereal prices; spot milk prices will increase as sterling weakens; and meat prices will be helped both by the exchange rate, lower production levels, and increased consumption as consumer confidence returns, though it may be 2000 before there is much impact on fatstock prices in Britain.

Mr Page went on to add: "There is no doubt that farmers are suffering their lowest income levels for almost a decade, and that 1998 will provide little relief for most of them. The upside is that the worst should be behind us this year and we expect a slow but steady recovery to begin towards the end of 1998 or early 1999."

Training partnership reaps rewards

A partnership with a national manufacturer of agricultural machinery has reaped rewards for a Leicestershire college. Brooksby College, Melton Mowbray, has been awarded a National Training Award for its specialist training of Modern Apprentice service engineers, in conjunction with East Midlands manufacturers John Deere Ltd.

At a regional ceremony last week, the Brooksby/John Deere partnership was one of just two Leicestershire entrants to receive a prestigious National Training Award, locally co-ordinated by Leicestershire TEC. The award ceremony was hosted by Angela Rippon, with guest speaker Duncan Goodhew. There were nearly 1000 entries for the 1997 awards, and of the 92 national winners, John Deere Ltd was the only agricultural equipment company to receive a National Training Award this year.

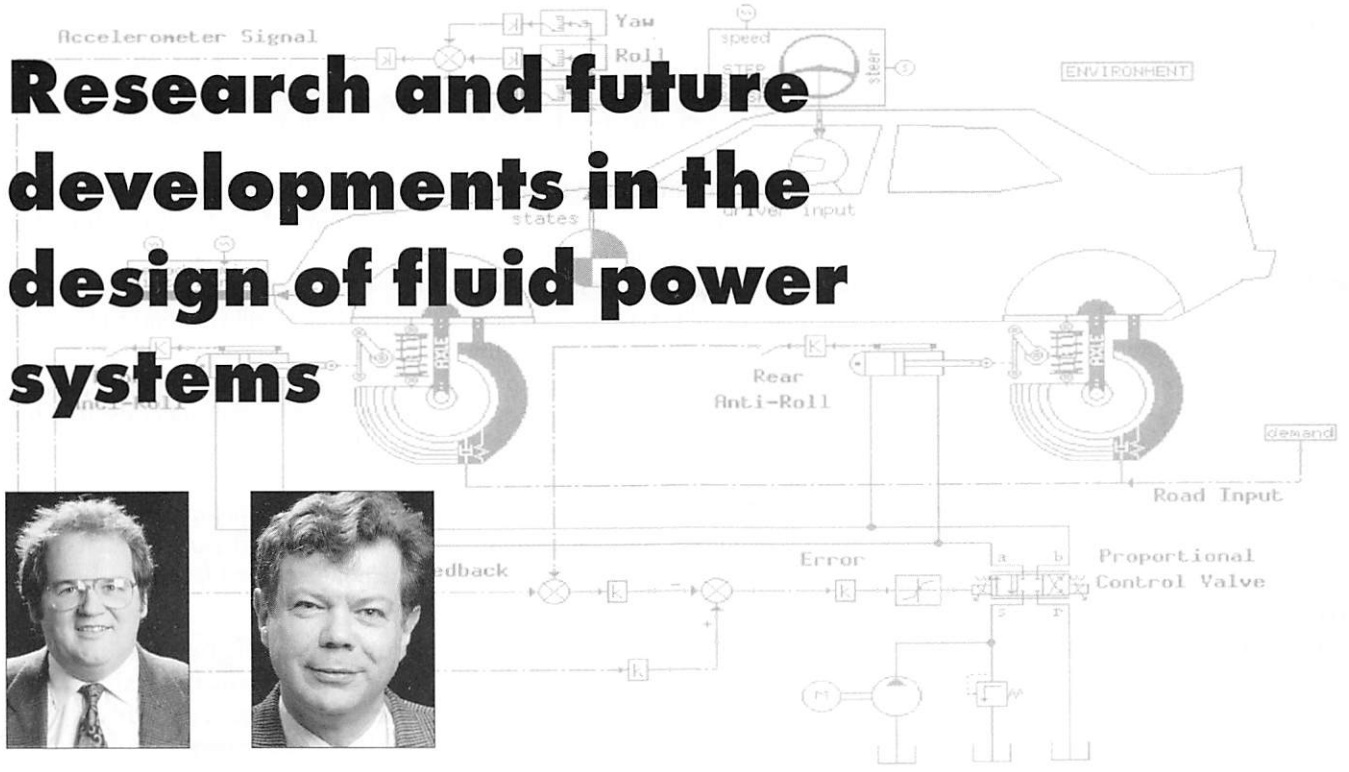
Since the partnership was established seven years ago, some 39 apprentices from as far afield as the Outer Hebrides and Weymouth have achieved the John Deere Servicing Certificate in addition to successfully completing the City and Guilds Service Engineering Course.

"We are absolutely over the moon, it is fantastic to gain recognition for what is actually a unique programme. It is a tribute to the commitment of Leicestershire TEC, John Deere and the students themselves," said Course Co-ordinator Richard Trevarthen.

John Deere relies upon a network of over 100 dealers to sell and service its agricultural equipment. Some ten years ago, increasing sophistication and new technology led to concerns that apprentice service engineers were not receiving quality training to gain the necessary technical skills. This led to the development of the partnership with Brooksby College. With enrolment at around 22 each year, there is currently a waiting list of around 30.

"We are delighted that Brooksby College has been singled out as a model centre for Modem Apprenticeship training. Modern Apprenticeships offer young people an opportunity to gain recognised qualifications and employers an assurance that their apprentices are being trained to the highest industry standards," said Kathy Booth of Leicestershire TEC.

Research and future developments in the design of fluid power systems



Edmund Hughes and Derek Tilley

The Engineering Design Centre in Fluid Power Systems (EDC), funded by the Engineering and Physical Sciences Research Council (EPSRC), was established in the Department of Mechanical Engineering, University of Bath in 1992 to develop computer based techniques and tools to improve the design of fluid power systems. This article describes the research activities by focusing on work currently being undertaken, and in doing so highlights to the reader future likely developments in fluid power design.

Introduction

Fluid power hydraulic systems are used as a source of power in many industries. Examples include mobile equipment (excavators, agricultural equipment), aerospace (flight controls and landing gear), automotive (suspension, power steering), marine (winches, stabilisers and cranes), and manufacturing (presses, injection moulding and food processing machines).

A typical fluid power system consists of a pump, driven by an electric motor or engine, control valves, interconnecting pipework and a linear or rotary actuator to drive the load. The design of hydraulic systems is not straightforward and, as a consequence, often fail to operate satisfactorily and can be very noisy.

As a result of dialogue with the hydraulics industry, research within the EDC has focused on a number of design aspects including:

- system design and performance evaluation;
- design of circuit spatial layout to minimise vibration and noise;
- circuit configuration design;
- environmental impact.

Figure 1 illustrates how this research work will address these areas and assist in the development of computer tools to aid the design of fluid power systems. Several of the research projects are described below.

Dr Edmund Hughes, AMIAgrE, is a Research Officer and Dr Derek Tilley is Manager, Engineering Design Centre in Fluid Power Systems, Department of Mechanical Engineering, University of Bath, Bath, BA2 7AY.

Development of a computerised design methodology for fluid power systems

Fluid power systems have many advantages, including high power density and ease of control, with the result being their use by many industries. Although the applications vary considerably from industry to industry, the systems are often constructed using standard components and circuit configurations. For example, hydraulic circuits are based on open or closed loop designs, with power sources based on variable or fixed velocity prime movers and fixed or variable delivery positive displacement pumps. Hydraulic motors or linear actuators convey the loads and control functions are undertaken using flow and pressure control valves. Designers also face comparable technical problems relating to system dynamics, fluid heating, noise and safety.

Industrially generic design methodology

Commonality between the design requirements of the industries using fluid power can be exploited to provide considerable benefits. Development of an industrially generic design methodology applicable across a wide range of industries is therefore sought through the adoption of a common approach to fluid power systems design.

Fluid power design research has previously enabled the development of computer simulation techniques for performance evaluation. Use of these techniques leads to increased customer confidence and shorter development times resulting in a more economic product. Performance evaluation is, however, only part of the design process. Evidence suggests that the concept of total design, as described in the literature, is not currently applied to fluid power design in many small to medium sized companies. It is suggested that these companies would benefit greatly from a focused design methodology that exploits good design practice.

Structured system design using computer techniques

There are many practising design engineers who have not received formal training in fluid power technology and, as a consequence, often produce inadequate designs. Poor design is no longer acceptable and users now expect their systems to be efficient, incorporate modern technology, be reliable, quiet and leak free!

When designing fluid power systems the designer must consider many different issues that will effect the technical and commercial success of the product. Examples include appropriate international and national standards, legislation and environmental factors whilst maintaining operational performance. Any of these could be overlooked due to a lack of technical awareness or because of a poor design protocol. Such problems would not arise if a structured approach to design were adopted. Computers are ideal tools for such tasks, and could be used to lead the designer through the design process in a structured interactive manner.

Designers usually refer to documents as and when required - conventionally, a printed manual. This type of document is not ideal as it is difficult to match the material to the needs of both inexperienced and experienced designers. A better approach is the use of computer based learning techniques to supplement conventional textbooks. This would provide access to a continually updating database, whilst allowing audio visual presentations to be included. In addition, the software can be structured to allow users to follow different routes according to their particular needs. Such an approach is considered to be ideally suited to the needs of fluid power designers.

Integration of design software packages

Many fluid power companies use computer-draughting software to produce circuit layouts, varying in complexity from simple schematic diagrams through to fully detailed engineering layouts. Problems arise when computer simulation is used to evaluate the system performance. The circuit must be redrawn in a recognisable format using the graphical tools provided by the simulation software. This process is clearly not cost-effective and time would be saved if circuit files could be passed directly between the packages.

Although there is a move to develop standardised communication protocols for simulation packages, no standard interface currently exists for software in general. As a consequence, packages use different approaches for storing data files. This prevents software from sharing common files. This can be overcome using a conversion process in which specially produced software changes the data format to suit the particular requirements of the packages being linked. It is proposed to use such an approach to allow circuit information to be passed between the draughting and simulation packages.

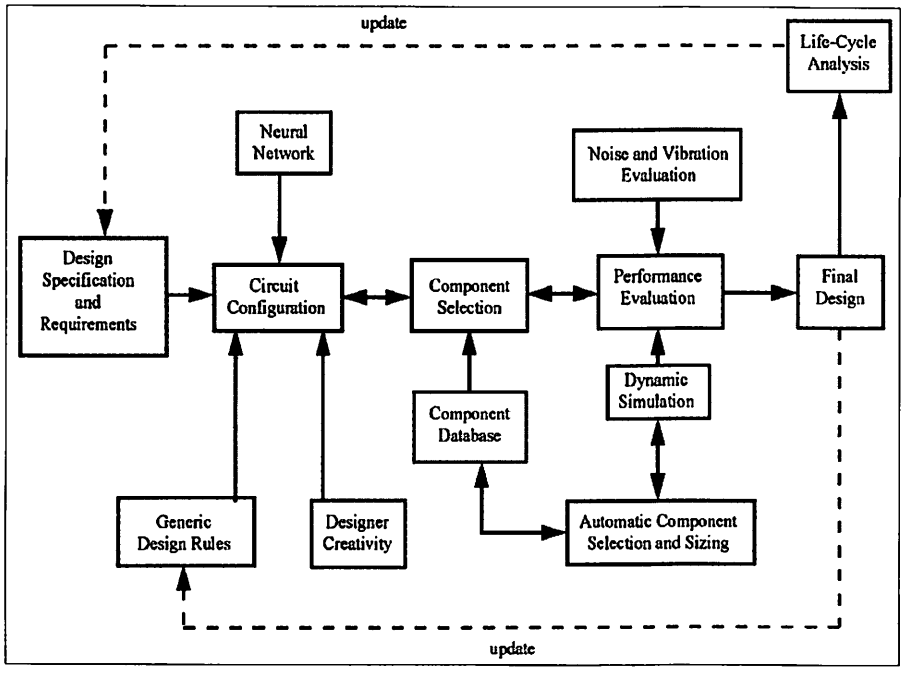


Fig. 1 Elements of future fluid power system design.

Strategic configuration design for hybrid domains using the axiomatic approach and machine learning

In the context of systems design and engineering, the choice of power transmission media for products and machines is becoming increasingly complex. The modularisation of hydraulic components and recent developments such as electric actuators and guided pneumatic actuators with feedback increase this complexity. It is clear that at the concept stage strategic decisions need to be made about the type of drive system to be employed. Equally, products and machines are more and more a hybrid combination of technologies, i.e. combining mechanical, hydraulic, electrical and pneumatic components.

A research programme on configuration design using the axiomatic approach and neural networks is being extended into the area of strategic configuration design of hybrid systems. By analysing examples of hybrid systems, the approach permits computers to 'learn' rules and associations which can be applied to develop novel solutions.

Work within the Department of Mechanical Engineering on the problems of configuring and analysing mechanical assemblies and sub-assemblies, particularly with standard components, has already provided relevant transferable knowledge into this work.

Environmental Design of Fluid Power Systems

There are growing health and safety im-

plications, world-wide, over noise generated by all types of machinery. Hydraulic systems in particular have a reputation for producing unacceptably high noise levels and so research is focusing on its reduction. Likewise, environmental concerns over the polluting nature of mineral oils has resulted in legislation that is forcing manufacturers to investigate the use of biodegradable fluids. This has emphasised the future importance of undertaking life-cycle analysis of fluid power systems as a requirement of good design practice.

Design of circuit spatial layout to minimise vibration and noise

There is a lack of specific design tools to minimise vibration and noise as existing methods of tackling noise problems rely heavily on trial and error or use simple empirical rules. Empirical approaches are often ineffective as a result of the complex mechanical and acoustic couplings involved. A software package that enables the designer to assess and optimise a 'quiet' hydraulic circuit at the design stage is therefore highly desirable.

Some work on predicting vibration of pipework has been undertaken in the USA and Japan, with specific reference to vehicle power steering systems. As there is very little published work on hydraulic circuit noise and vibration for both mobile, including agricultural equipment, and industrial applications, there is clear scope to support designers in UK industry by taking a lead in this area.

Computer software that enables noise assessment and minimisation at the design stage is being developed at the EDC. The work undertaken to date has extended previous mathematical models. In addition, frequency-dependent fluid viscosity has been incorporated into the model and been found to improve significantly the accuracy of prediction, especially at circuit resonant frequencies. These results have significantly enhanced the possibility of circuit noise and vibration optimisation that is the current concern of the project.

Life-cycle analysis of alternative fluid power systems

Life-cycle analysis is growing in importance as an element of good design practice. In fluid power systems, alternative fluids have been investigated and several published papers give preliminary results of the operational performances of biodegradable fluid. More recently there has been a resurgence of interest in the use of raw water. At present the capital costs of circuit components for use with water are 1.5 to 5 times the cost of components for use with mineral oil.

Designers therefore need tools to assess the true life costing of alternative solutions and so the EDC research is focusing on applying modern life-cycle assessment techniques in the context of design within what is a novel area: fluid power systems. Life-cycle assessment involves the entire life-cycle of the product or activity from 'cradle-to-grave'. A cost analysis examines the implications of alternative designs, in terms of capital investment and discounted running costs, and is used, in part, for other analyses, such as energy analysis. Finally, the environmental life-cycle consequences of the alternative designs are examined, particularly in terms of various pollutant emissions, an approach known as environmental impact assessment.

Summary

The Engineering Design Centre in Fluid Power Systems was established to develop computer based techniques and tools to improve the design of fluid power systems.

This is currently being achieved through:

- research directed to the development of computer tools to assist in the design of fluid power systems;
- use of a computer based approach arranged to lead the designer through the design process in a structured interactive manner;
- development of computer techniques to allow data to be exchanged between fluid power circuit draughting software and performance assessment packages;
- software packages that enable the designer to assess and optimise a quiet hydraulic circuit at the design stage;
- the application of modern life-cycle assessment techniques in the context of design within fluid power systems.

The driving force behind the research is its relevance to the needs of industry. A clear commonality between the design requirements of the industries using fluid power mean considerable benefits can be gained by the adoption of a common approach to systems design. In particular, small to medium sized companies can benefit greatly from a focused design methodology that exploits good design practice.

Make an Hydraulic Link

You could benefit from providing key input to our project. Our aim is to develop an **industrially generic methodology for fluid power systems** that exploits good design practice.

The *Engineering Design Centre welcomes industrial involvement in its project activities* and is currently seeking to contact persons involved in the design of fluid power systems in the agricultural, horticultural, and amenity engineering industries. We are particularly keen to receive input from individuals working on their own or in small company based design teams. The input will take the form of a completed questionnaire and, where appropriate, a company visit. Respondents to the questionnaire will be kept informed of the progress of the work.

For further information please contact: **Dr Edmund Hughes, Engineering Design Centre in Fluid Power Systems, Department of Mechanical Engineering, University of Bath, Bath, BA2 7AY.**
Tel: (01225) 826131. Fax: (01225) 826928.
E-mail: E.J.Hughes@bath.ac.uk

Covert chemicals

Canthaxanthin, an orange-red pigment, is currently permitted for use in animal feeds primarily to colour egg yolks and the flesh of farmed salmon and trout. Although an Acceptable Daily Intake (ADI) has been specified, there is currently no legal requirement for the use of substances such as canthaxanthin to be included on the food product label.

In June 1997, the EU Scientific Committee for Food set an Acceptable Daily Intake of 0.03 mg/kg bw for this pigment. After considering further data on the potential intakes by infants and young children, the Food Advisory Committee was satisfied that the dietary intakes of canthaxanthin by consumers of eggs and farmed fish were very unlikely to exceed the ADI which applies equally to all age groups.

The Committee concluded that the use of canthaxanthin in animal feed did not give rise to any food safety concerns but agreed to review the need for any such food labelling at a future date.

Meanwhile, be sure to check the yolks before buying your eggs!

Ideas commercialised for SMEs

A firm based at the University of Warwick Science Park is offering a new service to help innovators and SMEs to get their ideas into the market.

The scheme has been designed by Mark Evans, a partner in the firm. Evans has based the process on the innovation strategy of some large engineering companies. Until last year, he worked for Rolls-Royce Industrial and Marine Gas Turbines, helping to evaluate and develop new technology.

The London International Inventions Fair in November was chosen to launch the service, to bring it to the attention of lone innovators. Evans believes they face the largest obstacles, leading to the failure of many good products. Small and medium size companies should also benefit. Often their intellectual property remains un-exploited. Sometimes this is simply because it is outside their core business and would divert key staff.

A high level feasibility study at the start of each project is a key component to the scheme. It is inexpensive and gives an early indication of potential. It is subsequently used to get support for a technical and business development programme. The final stage includes a promotion method based on financial benefits. Evans' company project manages the whole process, freeing staff of the company that owns the idea to concentrate on core activities.

The company, Coupland Bell, is building a network of firms and university departments across the country, to provide specialist services. A patent agent and a legal firm already support the scheme.

Contact: **Mark Evans, Coupland Bell Ltd, Barclays Venture Centre, University of Warwick Science Park, Sir William Lyons Road, Coventry, CV4 7EZ. Tel: 01926 777566.**

Smart software helps business

How do you turn data into business advantage; identify market opportunities before your competitors; make significant cost savings; achieve real operational efficiencies?

The answer lies in discovering the valuable information hidden in your electronic data and using it to make informed business decisions. This is the key to success in today's business environment.

Smart software provides the tools to accomplish this in an affordable and easy to use way. The underlying technologies are well established and the recent increases in computer power mean they are now available on the desktop.

ERA Technology has been funded by the DTI to manage a Software Technology Club (SSTC) to help business exploit computer software for competitive advantage. The SSTC Club is part of a wider DTI initiative to help UK companies gain a greater awareness and knowledge of the available intelligent processing software technologies and how to benefit from them. It will cover both the practical issues involved and the competitive benefits to be gained, through a series of technology transfer activities including seminars, tutorials, practical workshops and application demonstrator projects.

Whatever the size of the business, and regardless of the type of activity in which it is engaged, this club will guide participants through the maze of products and technologies available.

For further information, contact: **Anita Taylor at ERA Technology, tel: 01372 367000**, or visit the SSTC Club site at http://www.era.co.uk/proj/sstc/sstc.htm.

A national beacon of excellence from Halton College for land-based industries

Halton College has just won the prestigious National Beacon Award for its ground-breaking NVQ (National Vocational Qualification) programmes in construction, horticulture and conservation. The Award is sponsored by City & Guilds; the largest vocational assessment and awarding body in the United Kingdom.

The Beacon Awards Programme, first launched in 1994, is sponsored by leading businesses and organisations as part of their commitment to enhancing education and training provision in colleges across the UK. As well as City & Guilds, sponsors include BBC Education, BT, Marks & Spencer and The Post Office.

Halton College, Widnes, is set in an area which has suffered environmental damage and is currently the focus of extensive efforts to improve the environment. Students have embraced the opportunity to acquire hands-on-experience and have worked on practical projects with a number of agencies and firms, some of whom were present at the award-giving ceremony. Students gained immensely from their involvement, developing key skills necessary for employment and frequently taking up offers of full or part-time employment.

Dr Nick Carey, Director General at City & Guilds presented the Principal of Halton College, Martin Jenkins, with a cheque for £3,000 at a special award-giving ceremony held on (13 February 1998) at Halton College. As he accepted the award, Martin Jenkins said: "I am delighted to receive this award in recognition of the innovative and excellent community work undertaken by staff at Halton College. We regard ourselves as a beaming resource for the community that we serve. The award reflects such community service and will provide further impetus for our students' work".

Environmentally friendly cyber conference saves 12 million air miles

Over 12 million air miles and the associated environmental emissions have been saved by staging the world's first environmental conference entirely on the World Wide Web. Environment97 was organised by the Institution of Chemical Engineers as part of the Engineering Council's 20/20 Vision Programme.

The cyber conference has highlighted the role of engineers in environmental protection. It has already prevented more than 654 tonnes of $C0_2$ from entering the atmosphere by enabling the 7,000 delegates attending the conference to do so without leaving their homes or offices.

All those registered to attend Environment97 were asked where they lived and how they would have travelled to an ordinary 'flesh' conference. Analysis shows that holding the conference on the Internet has saved a total of 26,410 walking miles, 33,300 bicycle miles, 33,100 motorbike miles, 627,200 car miles, 69,300 coach miles, 834,400 train miles and 12.45 million air miles.

Of course, the energy expended running the computer needs to be taken into account, but this has amounted to only 2.38 tonnes of $C0_2$.

The Conference was held between 3 and 14 November 1997, but the web site will be kept open all year. More than 140 papers were presented to delegates and the list of distinguished contributors included Sir Ronald Hampel, Chairman of ICI, Jaqueline Aliosi De Larderel, Director of the United Nations Environmental Programme and Michael Meacher MP, Minister for the Environment.

Delegates were given the opportunity to voice their opinions and have their questions answered by speakers. Dr. Mark Smith, the Manager of Safety, Health and Environment at the IChemE says: "While Environment97 will not sound the death knell for 'flesh' conferencing, it does demonstrate the quiet revolution that has happened in the last few years in the field of information technology."

Book Reviews

Precision Agriculture: spatial and temporal variability of environmental quality

(Ciba Foundation symposium 210)

Editors: John V Lake, G R Bock and J A Goodie

ISBN 0-471-97455-2

(Sorry, no price!)

This work contains the papers from a symposium held in collaboration with the European Environmental Research Organisations, January 21-23, 1997 in Wageningen, The Netherlands.

As with any such book containing the collected papers of leading researchers from a range of relevant disciplines, it is 'bound to be state-of-the-art stuff'.

It is particularly exciting as it deals with the science behind precision agriculture. This relatively new field of science takes into account the in-field variability to enable the precise integrating of interventions such as crop spray and fertiliser applications only when and where they are needed. Such practices thereby having the advantages of maximising production whilst minimising environmental impact, a unique combination.

Advantages in precision farming are only made possible by advances in farming technology, procedures for mapping and interpolating spatial patterns, and GIS for overlaying and interpolating soils, landscape and crops. Many of these disciplines are considered in the work.

The papers deal with sampling techniques, crop growth models, the use of remote sensing data, GIS, precision weed management and statistical methods.

The production by Wiley is first class and all illustrations are faithfully reproduced (for a change!!). The book represents a thorough, critical, up-to-date review of this important subject. It will be of great use to all of those involved in the research and development of Precision Agriculture.

Three Decades of Marshall Tractors

by Peter Anderson

Publisher: Farming Press, Miller Freeman plc

Price: £24.95

Another in the seemingly endless series of 'Tractors of the Past'. The difference with this one is in the depth of coverage. Where as many of the type are attractive picture albums, this book provides sufficient detail to give a good understanding of the Marshall history during its prime, between 1930 and the end of the 1960s.

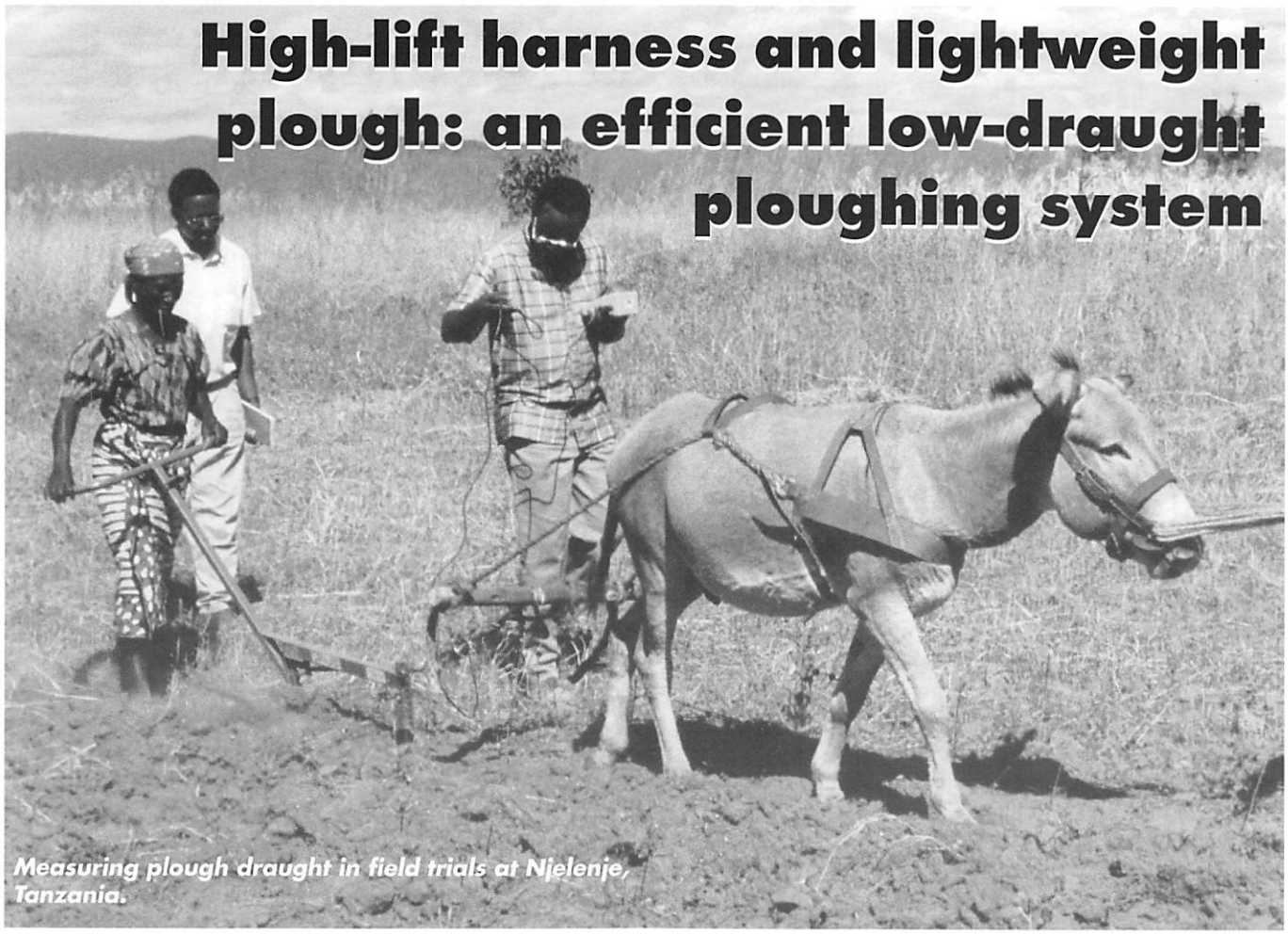
Yes, it has the high quality presentation which Farming Press have made their trade mark. The book includes some 279 colour and black and white illustrations. As usual this includes rare archive photographs and company publicity, the extra component being excellent quality section diagrams, which provide a much more informed documentation.

The story starts with an outline of Marshall's success with steam engines in the 19th Century. It moves smoothly on to the development, teething troubles and final success of Marshall Tractors in all its guises - the book finishes by describing the environment that has led to the reductions in production, to the present state where TM 155 crawler tractors made to order are the only output.

Peter Anderson is undoubtedly an enthusiast and something of an authority on Marshall Tractors. He has produced a first class book on this subject.

MJH

High-lift harness and lightweight plough: an efficient low-draught ploughing system



Measuring plough draught in field trials at Njelenje, Tanzania.

Frank M Inns

1. Development of a high-lift harness and lightweight plough system

Background to the 'high-lift' system

Draught animal cultivation systems have been the subject of much research for several thousand years. Until recently, it has been conducted by farmers on a trial and error basis, resulting in some remarkably efficient harness/implement combinations. More recent investigations have concentrated on implement design without considering the interaction between animal and implement, in contrast to the detailed investigations which have been made into the hitching of tractor-pulled implements.

Mouat and Coleman (1954) showed that the draught, H, of a cultivation implement is a function of the vertical force, V, acting on it and the angle, α, at which it is being pulled. The relationship may be stated in the form of a Tillage Implement Draught Equation (TIDE) as:

$$H = V/\tan \alpha$$

or, in words:

The draught of a cultivation implement varies directly with the effective vertical force (e.v.f.) acting on it and inversely with the tangent of the angle at which it is being pulled.

Although this relationship is very simple, its implications are quite profound. They have been explored in some detail by Inns (1990) with consequences which sometimes conflicted with the perceptions of designers and other experts, but were generally in accordance with the experience of users.

Frank Inns, FIAgrE, was formerly Professor of Agricultural Machinery Engineering at Silsoe College and is now a Consultant in Small Farm Mechanisation. His address is: 53 Alameda Road, Ampthill, Bedford, MK45 2LA, tel. 01525 402508.

Experimental verification of the relationship between plough draught and angle of pull

It seemed necessary to demonstrate that the TIDE did give a true prediction of the relationship between plough draught and the angle of pull, α - consequently field experiments were conducted at the Centre for Tropical Veterinary Medicine (CTVM), Edinburgh (Inns & Krause, 1995) using a donkey and a 15 cm mouldboard plough weighing 18 kg. The predicted relationship was confirmed. It was then decided to face the challenge of designing a harness/plough system to match the draught capability of a single donkey, *i.e.* about 200 N to 250 N. This challenge is relevant to current circumstances in many developing countries in Africa and elsewhere, where there is a shortage of traditional draught animals for small-scale farming and donkeys are increasingly recognised as being an underutilised resource.

Preliminary trials were made at CTVM using a breastband harness fitted with a hipstrap to vary the angle of pull between about 20° to 35° *(as shown in*

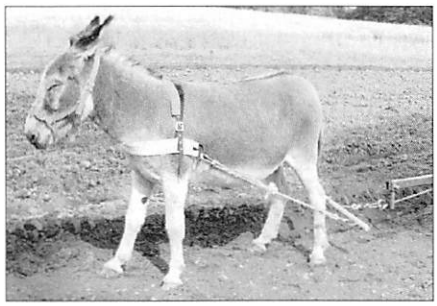


Fig. 1 Plain breastband harness - angle of pull fixed at about 20 degrees.

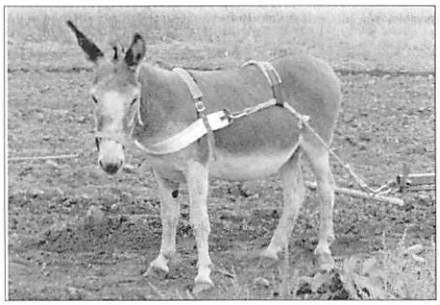


Fig. 2 Breastband harness modified by addition of an adjustable hip strap - angle of pull can be varied from about 20 to 35 degrees.

Figures 1 and 2) and a 11.5 cm plough weighing about 12 kg, which was designed to cope with the variation in pull angle. Results confirmed expectations and further trials were undertaken on-farm in conjunction with farmers in Tanzania *(see Title Photograph)*, with results as shown in *Figure 3*. In general, it appears that plough draught is halved when the angle of pull is increased from 20° to 30°, making all the difference between a no-go situation and one which the donkey can cope with throughout a working day.

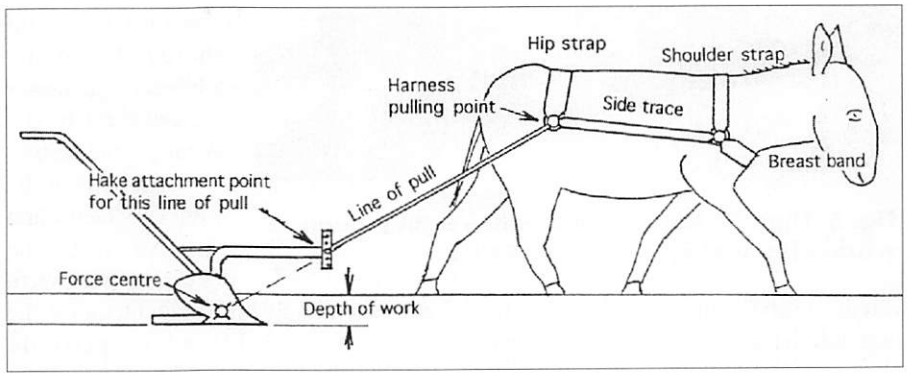


Fig. 4 Harness design: typical high-lift harness (breast band type) suitable for donkeys and other equines. This harness gives an angle of pull of about 30 degrees, or slightly more.

Design of a high-lift harness and dedicated lightweight plough

Following from the above experiences, a simple and cheap 'high-lift' breastband type harness has been designed to provide an angle of pull of 30° approximately, as shown in *Figure 4*. The breastband harness is suitable for a single donkey, horse or mule - it is possible to design an alternative high-lift harness for oxen. By standardising the angle of pull it has been possible to design a dedicated lightweight plough weighing 8 kg and suited to manufacture in small local workshops. The harness and plough have recently (January 1998) been evaluated for use in Bolivia. Results have been excellent when working with either donkey or horse as shown in *Figures 5 and 6*. Versions of the harness and plough have been manufactured locally in Bolivia.

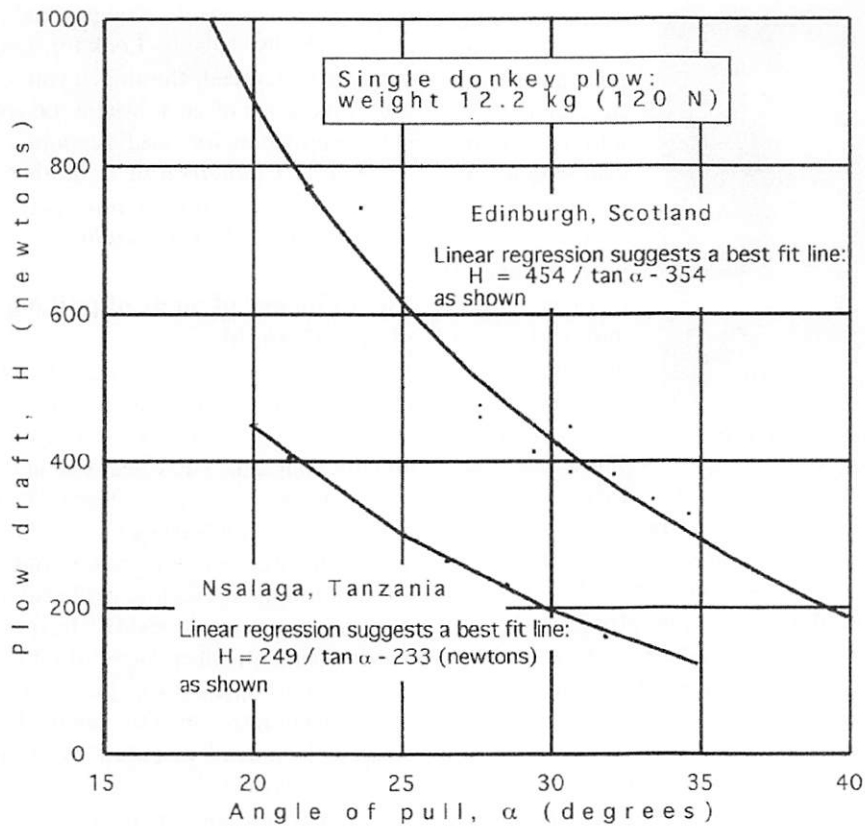


Fig. 3 Variation of draught with angle of pull: results of field trials in Scotland and Tanzania.

Advantages of the high-lift system

Advantages of the high-lift system, leading to a high degree of user-friendliness, include:

- improved plough efficiency (greater proportion of useful work);
- reduced draught load on the animals (or more useful work for the same draught level);
- easier adjustment (skids or wheels are not needed);
- simple harness (cheap, easily made locally); and
- lighter plough (cheaper, more easily transported and handled).

The improvement in plough efficiency arises from the combination of reduced plough weight and increased uplift on it as a result of the steeper angle of pull. These combine to reduce the load carried by the wheels of a wheeled plough or, in the case of a wheel-less plough, the load reduction occurs between the underside of the plough and the soil. Rolling resistance at the wheels

Fig. 5 High-lift harness and lightweight plough at work with donkey, Capinota, Bolivia.

is reduced and/or the frictional resistance underneath the plough. Plough efficiency is improved by reducing these parasitic components of draught. There are preliminary indications that share wear is also reduced.

2. Some myths and realities relating to animal powered ploughs

The investigations and design work reported above involved considerable practical work, carefully undertaken, observed and thought about. Some light may be thrown on existing animal draught controversies as a spin-off.

Fig. 6 High-lift harness and lightweight plough at work with horse, Cochabamba, Bolivia.

The influence of plough weight on plough draught

Farmers and other practitioners of animal-powered ploughing often make statements to the effect that "this plough is too heavy for my animals (to pull)". This conflicts with a long-held belief that "the weight of the plough has comparatively little effect on its draught" (Young, 1784, quoted by Mouat & Coleman, 1954) - an opinion which is still shared by many advisers and larger scale manufacturers. What are the facts?

Older ploughs were very heavy and the e.v.f. would be very large, with correspondingly high draught, unless the plough's weight were partially counteracted by upward-acting support force(s). This was done by supporting most of the weight on a large 'sole' or 'slade' - a long horizontal plate underneath the plough - or by wheels, skids or other devices. If the support force is large enough (not necessarily easy to achieve) the e.v.f. can then be reduced to a value which will result in an acceptable level of draught - but much of it will be parasitic draught caused by friction on the sole, or rolling resistance from the wheel(s), which do no useful work on the soil.

Over the years the use of improved materials and design allowed the plough to be made lighter. The support force did not need to be so great, the sole of the plough could be made smaller, the parasitic draught was reduced and hence the plough became more efficient. It also became easier to adjust, if it had been well designed, because it was no longer necessary to provide a very large support force.

Work animals can cope with a heavy plough if it is carefully adjusted to develop a large enough support force, but unnecessary weight makes it more awkward for the ploughperson to handle. Why suffer these difficulties when a lighter plough will avoid the adjustment involved and will also be cheaper and more efficient? Many locally made ploughs (Pakistan, Turkey, Jordan, *etc*) are relatively light and work very easily and effectively: thus it is the practitioners who have a better understanding of the fundamental relationship between plough weight and draught. The TIDE endorses the practitioners' viewpoint.

- ***A lighter plough has inherently less draught and is more user-friendly.***

Plough weight and penetration

It is often argued that weight is necessary to get the plough to penetrate to its working depth. The TIDE suggests a more subtle and effective approach - perhaps the e.v.f. is too small? What is the reason? Almost invariably, it is not because the weight (main downward force) is too little, but because support forces are too big. Unwanted support forces can arise under the point of a worn share, if there is insufficient clearance ('pitch', 'suck' or 'down suction') behind the share or sometimes because the lower edges of the mouldboards are pressing down hard on the soil and providing unwanted support along their bottom edges (the mouldboards of ridging bodies are often badly shaped). Look for shiny surfaces underneath the implement - a useful indicator of areas where the soil may be providing too much support.

- ***Lack of penetration is almost always a question of too much support, not a lack of weight.***

The influence of angle of pull on plough draught

The TIDE suggests that the draught of a plough will be reduced as the angle of pull is increased, if the e.v.f. acting on it remains constant. This effect was noted more than 150 years ago by Pusey (1840) who observed the advantages gained from a steeper angle of pull, but found it difficult to find a scientific explanation. Although some successful harness designs feature a steep angle of pull, it has been adopted through *ad hoc* development rather than by intent. The concept is indeed disputed by some specialist advisers.

It has been shown in theory and practice that plough draught can be very significantly reduced by using a steeper

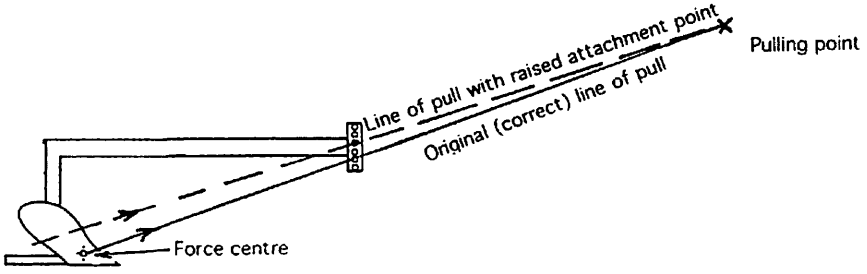


Fig. 7 The effect of raising the point of attachment of the pull chain. Showing how a raised attachment point reduces the angle of the line of pull but raises its line of action. The new line of pull creates a clockwise turning effect about the force centre, causing the plough to run nose down.

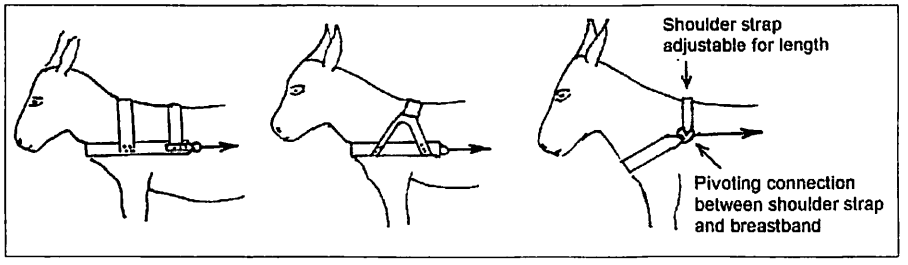
angle of pull. This fact can be used by designers and operators to improve system efficiency.

- ***For optimum results, and ease of control, the plough and harness must be designed as an integrated combination.***

Working adjustments to the plough - setting the plough into work

As is well known, the basic principle is to attach the pull chain (or rope) to the hake at the point where the line of pull and the hake adjustment coincide. If the chosen attachment point is not quite correct this will be shown up in work -. the plough will run either nose up or nose down. This can be corrected by a 'fine tuning' adjustment at the hake.

It is suspected that some ploughs are poorly designed, with the hitch points positioned incorrectly so that there is no hitch point available on the line of pull joining the harness pulling point and the plough's force centre. In such cases, the plough cannot be adjusted to run with correct balance and the ploughperson will have to struggle continuously to hold the plough in a reasonable working alignment - this can be an extremely tiring process. Correct design is essential for joyful ploughing.



The two illustrations to the left show breast band harnesses with rigid (usually stitched) connections to the shoulder straps - the breastband is held vertical and the top edge tends to dig into the donkey's chest. The right hand illustration shows a breastband harness with adjustable shoulder strap which is free to pivot at its connection to the breastband - these arrangements allow the breast band to be set to the correct height and to take up its most comfortable angle.

Fig. 8 Preferred arrangement for a breastband harness, shown on the right.

Working adjustments to the plough - background

Farmers are often criticised for not using the hake attachment points or other form of regulator correctly, or even for throwing the regulator away and wrapping the pull chain round the plough beam in a permanent position. But perhaps it is the critics who are at fault for not giving good (and often conflicting) advice on adjustment of the point of attachment to the hake? There are two matters to consider: setting the plough into work and changing the depth of work.

Working adjustments to the plough - changing the depth of work

Training manuals often state that to increase the depth of ploughing the pull chain should be attached at a higher point on the hake. This does reduce the angle of pull (very slightly) and should therefore increase the draught and depth of work, but unfortunately it also changes the location of the line of pull so that it no longer passes through the force centre ('centre of resistance') of the plough but passes above it to produce a nose-down turning effect *(Figure 7)*.

The manuals then advise that the nose-down movement should be counteracted by lowering the nose wheel into contact with the ground to make the plough run level again. But this produces two contradictory effects. First: the angle of pull is reduced - draught and depth of work should be increased. Second: the wheel develops a support force from the soil - this acts to reduce the e.v.f. and hence also the draught and depth of work. The net effect on depth of work is zero, but the wheel and its bearings are put under load unnecessarily, leading to excessive bearing wear. Plough efficiency is reduced due to rolling resistance of the wheel.

The correct method of adjusting depth of work is by changing the angle of pull and going through the initial setting procedure again using the hake attachment to fine tune the plough for level running.

Working adjustments to the plough - conclusion

So are farmers justified in their suspicion - and often their rejection - of specified adjustment procedures? Are they making a logical response? The answer is probably; "Yes", for two reasons. First: once a correct adjustment is achieved, there is little reason for changing it if the line of pull is not changed - this is only likely to happen if the length of the pull chain is altered or if different draught animals are used which differ significantly in height. Second: the adjustment procedures they have been taught were probably confusing and may have been incorrect. The nosewheel, if used in the way which is often written about and advised, causes a rolling resistance which reduces efficiency. Its only useful function is to assist in turning and transporting the plough but, if this is necessary, the plough is too heavy

anyway!

- ***The nose wheel (or skid) that is usually fitted to swing ploughs is a heavy, expensive and unnecessary distraction which, if the plough is well designed, is a hindrance to its proper adjustment and control.***

Harness design

A breast band harness was chosen for the experimental work referred to above because, compared with the main alternatives, it is simpler, cheaper and more easily made locally and is therefore more user-friendly and accessible to small scale farmers.

One particular feature of the harness was observed to be particularly helpful to the donkey's comfort in use and can easily be incorporated into other breastband designs. The ability to adjust the breastband to fit comfortably on the animal's chest - not its neck! - was greatly aided by making the shoulder strap adjustable for length and by connecting it to the breastband by a fitting (a ring in this case) which allowed them to pivot relative to each other. This allowed the breastband to be adjusted for height and to sit at an angle to give maximum comfort.

Many existing harness have a rigid stitched connection between the breastband and the shoulder strap (and any backstrap(s) which may be fitted) so that the breastband is held vertically at the chest. The top edge of the breastband then digs hard into the animal - particularly if the breastband is made of rigid material such as transmission belting, which appears to be a favoured material. This is the case with the donkey shown ploughing in the *Title Photograph* obviously not desirable.

The shoulder strap and breastband form the basic assembly used in a breastband harness and *Figure 8* illustrates some of their desirable and less desirable features as mentioned above.

The Douglas Bomford Trust

The Douglas Bomford Trust

Assisting the further development of Agricultural Engineering and Mechanisation through sponsored research, and career development programmes.

Further information from:
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Bedford MK45 4EL
Tel: 01525 861144

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UK farm incomes in 1997

Total Income From Farming, TIFF, which represents the income to farmers, partners, directors, their spouses and family workers, is estimated to have fallen by 35 per cent, or by 37 per cent in real terms. Farming Income, which covers only farmers and their spouses, is estimated to have fallen by 45 per cent, or by 46 per cent in real terms. TIFF remains above the levels of the early 1990s in real terms.

The fall in TIFF in 1997 is largely due to lower prices received by farmers for all major commodities. The relative strength of sterling compared to 1996 has been a major factor underlying the fall in prices.

The value of the agricultural industry's gross output was 11 per cent lower. For cereals the value of output was 15 per cent lower whilst for livestock and livestock products it was 10 per cent lower. The cost of the industry's gross input was 4 per cent lower due to lower expenditure on animal feed.

The value of output of cattle and calves fell by £111 million or 6 per cent. In addition, payments to farmers within the Over Thirty Month Scheme, the Calf Processing Aid Scheme and the Selective Cull were £122 million lower.

The industry's productivity measured in terms of the volume of gross output per unit of all inputs rose by 2 per cent. The volume of output was 0.5 per cent higher whilst the volume of inputs used was 1.3 per cent lower.

Over the year interest rates rose and the industry's interest payments were 12.5 per cent higher. The cost of hired labour rose by 4.9 per cent despite a slight decrease in the overall amount of time worked.

Measures of cash flow, which may reflect more closely the variations in income perceived by farm households, show smaller decreases. In real terms, cash flow for the wider group, which includes directors and family workers, fell by 33 per cent whilst that for just farmers and their spouses fell by 42 per cent. These figures incorporate expenditure on capital formation but exclude the losses due to depreciation of capital assets.

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Spring 1998

World class engineers

Mike Heath, Director General, Engineering Council

We would all agree, I am sure, that a major task of the engineering profession is to enhance the influence of engineers at all levels of society, for a whole variety of reasons. One of the most important is to ensure the continued recruitment of talented young people of the highest calibre, and guarantee that their education, training and professional development prepare them as world class professional engineers. Another is to have greater input to the national decision-making process.

As engineers, we know better than most that a convincing argument rests on good evidence and facts. It is therefore surprising that these have been in short supply in the past. It has been an important aspiration of the new Engineering Council to rectify the situation and, as far as possible, act as the centre for factual information about engineers and engineering and assemble the necessary statistics.

Considerable progress has been made in this direction and I would like to take the opportunity of sharing with you some of the information and our deductions from it. For a start, we can demonstrate that engineering is for most a well-paid profession and that an engineering degree is one of the surest routes to business success.

A recent report by the Institution for Employment Studies tracked the job experiences of all Sussex University graduates over a 42 month period. It showed that, six months after graduation, engineering graduates were more likely to be employed than any other discipline. After 42 months, no engineers were working part time, unlike 14% of humanities and creative arts graduates. Average salaries were £15,750, beaten only by mathematical sciences graduates (mostly computer scientists) on £15,787.

The Engineering Council's 1997 Survey of Professional Engineers and Technicians illustrates that not only are salaries, on average, continuing to rise at a rate well above inflation, but unemployment rates are extremely low and still falling. With their earnings averaging £40,131, Chartered Engineers, for example, are better paid than Chartered and Certified Accountants (£28,033), solicitors (£34,860) or architects (£25,272).

Another recent study, this time by the Higher Education Funding Council for England and Wales, looking at 38 different disciplines, has shown that the salaries of engineering graduates ten years after graduation are in the top echelon of the earnings league. Their salaries are significantly bettered only by those of their peers pursuing careers in clinical dentistry, law and economics but are ahead, for example, of most medical professionals.

What about the prospects of getting to the top? Six per cent of all undergraduates are engineers so, pro rata, one might reasonably expect that six per cent of university vice-chancellors were engineers. In fact, the figure is 18 out of 107 or 17 per cent. And should anyone have any doubt about the engineering and scientific credentials of chief executives of FTSE 100 companies, a snapshot check of some 57 of them found that 11 were Chartered Engineers - again, a much higher proportion than would be expected pro rata.

A DTI sponsored study last May by the Institute for Employment Research into the chief executives of 43,000 manufacturing companies found that, of those who had formal qualifications, engineers and scientists outnumbered accountants three to one despite the professions being roughly equal in size.

It seems that industry cannot get enough engineers and there are shortages at every level. A new report from the Association of Graduate Recruiters shows that in both 1996 and 1997, good quality engineers were easily top of a list of shortfalls among their members. This is the message of new SARTOR - the new CEngs will be much sought after, but at least employers will be able to distinguish them from the rest.

Although the higher education establishments are turning out enough engineers by quantity (apart from a bulge from 1991 - 1994, acceptances to engineering degree courses at 17,000 per year, compare well with previous years), too many have neither the ability nor the competences that industry requires.

We have asked the Higher Education Statistics Agency (HESA) for statistics on A-level point scores for entrants to engineering degrees. In 1994 when many former polytechnics became universities, the scores dipped significantly as many academic institutions went for numbers rather than quality. The number of 24 plus point candidates seemed unchanged. The scores have recovered somewhat since then but are still disappointingly low. Although we are continuing to seek adequate output measures for higher education performance, these scores do give a crude indication that engineering

continued overleaf

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is not getting its fair share of the nation's academic quality. This is something, of course, that SARTOR is designed to address.

Another interesting piece of work is a study by the IEE on job advertisements for engineers. The number that specify Engineering Council registrants has been steadily rising and, taking the Daily Telegraph advertisement pages as an indicator, 35% now call for chartered status, so our efforts as a profession to maintain and improve standards are clearly valued.

All these statistics help us towards a clearer picture of where we are in engineering and where we might be going. There is much more work to be done in devilling out the statistics and drawing the right conclusions but I hope you will agree that work so far is encouraging.

The Digest of Engineering Statistics produced by the Engineering Council last year will be published annually and the 1998 edition will look very different to the 1997 edition, thanks to the many helpful suggestions made by Institutions. I hope, nevertheless, that anyone with further ideas on useful statistics we might investigate will let us know.

Membership movements

Mem No	*Name*	*From*	*To*
5249	A Baker	Kent	USA
6602	R W Causer	Surrey	Uganda
2720	R P Cherry	Essex	Ukraine
3586	M J Copeland	South Africa	Swaziland
3527	D N H Dagg	Italy	Ghana
4808	J M K Ellis	Bedfordshire	Wiltshire
6202	S J Gossage	Surrey	Dorset
3700	S R K Gray	Scotland	Canada
6323	V R Hamilton	Dorset	Essex
6129	J C A Henry	Devon	Cumbria
6653	C M Heslin	Essex	Ireland
6442	B Kotschoubey	London	Belgium
6302	H C Leigh-Firbank	Somerset	Warwickshire
6518	M W Peters	Devon	Bedfordshire
4127	G R Rudd	Buckinghamshire	Belgium
6621	C Saunders	Devon	Bedfordshire
6517	A D B Shorten	Bedfordshire	Cornwall
5439	M C Smith	Hampshire	Northamptonshire
4243	J B T Stephens	Wiltshire	Surrey
5633	J W Turnbull	Surrey	Oxfordshire
1685	D J van Rest	West Midlands	London
3557	M W von Kaufmann	Zambia	South Africa
6367	G P Wardle	Warwickshire	Staffordshire
3402	B H Webb	Philippines	New Zealand
2525	D T Wilkinson	Essex	Lincolnshire
3657	D B Williams	Warwickshire	Ukraine

Gone Away

Name	*Last known address*
J M Bunting	29 Summit Close, London, NW9 0UL
R J Richardson	'Logiegreen Cottage', 2 Foulford, Lesmahagow, Lanark ML11
M Whiting	90 Burnt Hill Road, Lower Bourne, Farnham, Surrey GU10 3LJ

Engineering Council Director General moves on

Mike Heath CB CBE CEng, Director General of the Engineering Council, has announced that he is to leave the Council at the end of June.

He joined the Council, the engineering profession's lead body, in May 1995 and has presided over the unification of the profession and the establishment of a successful working relationship between the Council and the professional Institutions. He has also been instrumental in forging much closer links between the Council and other representative bodies from within the engineering community.

After three years in a very demanding post, Mr Heath believes that the time has come to hand over executive responsibility for driving the profession forward. As he explained: "I feel that we have reached a natural break in the evolution of the Council. The partnership with the Institutions is now a reality and many of the major issues that faced us have been addressed. We have reached the end of a transitional phase and it seems a logical point to hand over the reins to someone else."

"After a busy career in the Army, latterly in the MoD, followed by a heavily loaded role with the Council, I also feel that I owe my wife and family a little more of my time," he added.

Under Mr Heath's leadership, a great deal has been achieved. The Council's financial position has been strengthened; a new regional network for the profession has been set-up; a revised version of SARTOR has been published; strong links with Government have been established; and a new executive team has been put in place at the Council to maintain the progress that has been made. Importantly, a comprehensive Corporate Plan has also been developed with ambitious future plans.

Mr Heath (57) is married with two children and three grandchildren. On leaving the Council, he intends to continue working on a part-time basis.

Energy technology for the future

Fossil Fuel Supply; Energy Conversion Processes; Energy Use in Buildings; and Energy in Transport were the key issues highlighted in the *20/20 Vision Energy Report,* given at the Engineering Council's *Engineering the Vision* Conference in London on 19th November. In her summary of the co-ordinated activities of the Joint Venture Study Group on Energy, Pam Liversidge, President of the Institution of Mechanical Engineers, focused on what she believes will be the key sectors of the energy scene in the year 2020. Conclusions were made in the following areas.

Fossil Fuel Supply

- There is a ready availability of gas, oil and coal. The world gas and oil industry currently finds on average twice as much energy each year as it uses.
- Fossil fuels will have to carry the major share of energy demand for the foreseeable future.
- The UK gas, oil and coal industries all use state-of-the-art engineering techniques and have extensive engineering expertise. This provides a significant potential base for export earning.
- All three industries in the UK have the disadvantage that their resources are difficult to win. It is crucial, therefore, to maintain a high level of UK engineering expertise to minimise the cost of developing UK fossil fuel resources.
- There is a need to establish education and training for engineers that is internationally competitive, and is set within a world perspective.
- The industries must redouble their efforts to explain engineering issues to the community.

Energy Conversion Processes

- Energy conversion and use will need to comply with the environmental contraints set by the Government and EU.
- Refinery operation now reflects tighter fuel quality specification and has changed to reflect market forces.
- Since privatisation of the electricity supply industry, UK power generating technology is currently suffering from the lack of R&D investment.
- Demand for new and replacement power generating capacity over the next 15-20 years offers abundant opportunities for UK industries.
- It is necessary to re-establish an infrastructure to build and operate nuclear plant on strictly commercial lines.
- The government has set what could be ambitious targets for the generation of renewable energy in the first two decades of the next century. The high capital cost and unpredictability of supply will determine whether renewable energy in gigawatt quantity is going to be worth while in the UK. This represents a challenge for the engineer.

Energy Use in Buildings

- Two thirds of electricity and three quarters of directly delivered gas is used in buildings. Consumption of energy has grown by 15% over the past 25 years.
- There is a potential for up to 30% cost savings in energy usage in buildings.
- Commentators vary in their predictions of the effect of CO_2 emissions on global warming. If the worst scenario is taken, there will need to be a reduction of 50% in the world CO_2 levels by the middle of the next century. Energy usage in buildings represents easily the largest area where substantial energy efficiency improvements can make a dramatic change to CO_2 emissions.
- The technology is available now to make the necessary dramatic reductions in energy consumption.
- The strict measures which have been suggested will be politically difficult to enforce, i.e. more demanding building regulations; buildings fuel tax to force energy efficiency measures; mandatory annual 'MOT' for buildings; mandatory energy efficiency labelling of all equipment used in buildings and, possibly, even the building itself.

Energy in Transport

- Transport overall is responsible for the most spectacular increase in energy consumption. It accounts today for up to a third of UK energy usage and is still rising. Four fifths of the transport energy is used on the roads and much of the remainder is used in the air.
- More efficient engines and better traffic management is helping to reduce the energy consumption of road vehicles.
- Worthwhile savings will come if drivers forsake their vehicles for public transport.
- Energy consumption on the railways accounts only for 2% of the transport total. The transfer of passengers and freight to rail will be 70% more fuel efficient.
- Sea transport is a fertile area for the design of both hulls and power units to enable higher speeds without fuel consumption increases. Diesel propulsion will continue to be the basic marine prime mover of the next century. Gas turbines are becoming increasingly attractive for faster vessels.
- Since the first jet aircraft, the fuel burn per seat has been reduced by 60% and further savings may be expected over 20 years.
- Better aircraft management will save up to 10% off current fuel consumption.

Risk management
This can be used to reduce claims and premiums, e.g. COSHH assessments, health and safety, risk assessments, risk reduction report (undertaken by surveyors). The main rules to follow are listed below:

- Under insurance does not pay.
- The business owner needs security.
- All businesses change, and therefore the insurance cover must be reviewed at least annually.
- Consider health insurance.

The engineer's role
The engineer has to negotiate with the repairer, monitor the repair and resolve any problems that may arise. The engineers with the NFU Mutual cover large geographical areas but must be prepared to visit accidents quickly. They also police the repairs and ensure the correct materials are being used. (One example was quoted where a £300 repair to a combine straw chopper was far more acceptable than a £2000 unit replacement). The engineer is mindful of new technology, for example, new paint systems.

The advice to farmers is always to notify NFU immediately an accident occurs; 'total losses' must be handled quickly, e.g. DVLC must be notified. Certain items such as mechanical or electrical failures had to be excluded from any claims. The speaker commented that many farmers still leave keys in machines, and it is important to lock cabs, etc. where possible.

One of the NFU speakers finished with a collection of humorous 'quotes' from insurance claim forms, insisting they had them before Jasper Carrot!

The evening's session had been very full and extremely informative, and could easily lead to (perhaps numerous) follow-up talks.

Institution membership changes

Admissions - a warm welcome to the following new members

Member
D R McCullough (Northern Ireland)

Associate Member
S D Clark (Hertfordshire)
G M Gillespie (Bedfordshire)
J O'Regan (Scotland)
J C Timmons (Republic of Ireland)

Associate
S D Ridland (Scotland)

Student
J K Bailey (Bedfordshire)
N Bashir (Bedfordshire)
J R Bishop (Worcestershire)
E Davidson (Norfolk)
W J Davies (W Midlands)
J R Evans (Northamptonshire)
C S Findlay (Scotland)
M R Hemsted (Tyne & Wear)
A Margiwiyatno (Bedfordshire)
S C Scott (Tyne & Wear)
R T Vaughan (Bedfordshire)
S Woods (Leicestershire)

Transfers - congratulations on achieving a further phase of your professional development

Member
M T Payne (Somerset)

Associate Member
M W Bell (Tyne & Wear)
G R Tulloch (Wiltshire)

Deaths - with great sadness, we record the death of:
J Aked (Zambia)
E Maggs (Bedfordshire)
A J Saul (Lincolnshire)
D W Sawers (Scotland)

Engineering Council

Registrations

CEng
P G Kaumbutho (Kenya)

EngTech
M W Bell (Tyne & Wear)

Insurance and risk management from the engineer's viewpoint

A talk was presented by ***Stephen Angel*** *(Aon Risk Services),* ***Nigel Pain*** *and* ***Lawrence Ellacot*** *(both of NFU Mutual Insurance Society) at the Herts & Essex Branch meeting on 11th November, and is summarised here in brief note form by* ***Richard Langley.***

Aon Risk Services is the second largest insurance broker in the world, and is the largest in the UK. 'Aon' apparently means 'family', and is based in the USA.

Providers of insurance
- Banks.
- Building Societies.
- Direct insurers/underwriters.
- Affinity groups, e.g. Age Concern, Saga.
- Insurance companies.
- Insurance brokers.

It was reported that the UK is the 'freest' market in Europe for insurance.

The role of the intermediary
- Risk evaluation, programme design, options.
- Quality market presentation.
- Access to all markets.
- Face to face negotiations.
- Evaluation of all quotations.
- Knowledge, skills, resources.
- Independent and impartial.

Current state of the market
- Globalisation of insurance.
- Merger mania - many companies are combining.
- Competition. There has been a 40% fall in prices of insurance over recent years, and it is very much a buyer's market. The UK tends to follow the USA. Insurance is at the moment a 'soft market'.
- Risk management. This involves the identification of risk and establishing what the risk exposure is, i.e. it is analysis and control. There will always be a number of options, e.g. to insure or not to insure? It was said that some companies are actually moving away from insurance.

Industry concerns
- Employer's liability, e.g. industrial injuries where personal injury claims can easily reach £3m.
- Pollution.
- Computers/technology. Apparently, it takes a thief only 12 seconds to remove a computer chip.
- 'Millennium risks'. Perhaps this problem has been overstated? There may though be countless hitches with anything having embedded chips in the year 2000.
- Tax.
- 'Soft' market, but may change soon?

Current issues
- Long term agreements vs long term deals.
- Rebate clauses, profit share.
- 'Added value'. This is definitely the 'flavour of the month'!
- Technology, e.g. e-mail links with clients.
- Risk management.
- Brokers often now charge a fixed fee to clients; commission is becoming less common.

NFU speakers

The insurance group started off with a few farmers in Stratford on Avon, and ever since has specialised in agricultural and 'rural' insurance. Insurance = protection of assets, e.g. from fire, theft, injury to others (culminating in millions of pounds worth of claims), damage to property.

What can insurance do?
- Compensates for financial loss, i.e. indemnity = putting back into the same financial position as you were before.
- Replacement cost/reinstatement, i.e. new for old.
- Peace of mind.

All insurances are similar, regardless of type. Some insurance is a legal requirement, e.g. motor insurance (which may include horse-boxes, tractors and ATVs). Other insurance, such as personal insurance, is becoming more important in today's climate.

Business insurances

May be tailored to specific businesses, e.g. contractors, diversification enterprises, agricultural mechanics. One example given was a minor impact that occurred in a farm cold store for cheeses, which resulted in a £6.5m claim for damages.

Other insurances required
- Money.
- Goods in transit, e.g. machinery on low loaders.
- Fidelity guarantee (i.e. when the secretary runs off with the farm cash!)
- Uncollected milk and bulk milk tank breakdowns.
- Computers.
- Boilers, refrigeration plant.
- Engineering insurance for inspection certificates eg lifting equipment.
- Statutory insurance.
- Lost income.
- Liabilities, including employer's, public, products (inclusive of defective workmanship).
- Main assets of business, i.e. people.
- Packages can be developed to suit particular businesses, and the BAGMA system is a good example.

The topic of insurance 'exclusions' was highlighted, although not discussed in depth. This can also cause certain controversy!

Communication technology - friend or foe?

Should engineers be aware of the social consequences of their work? *Yes.*
Are engineers responsible for the social consequences of their work? *Debatable.*
Do technological advances mean that individual privacy is threatened? *Yes and No!*
Should there be regulations to safeguard the privacy of the individual? *Probably...*

A forum on 'Liberty, Licence and Privacy - Do Technology and Regulation Conflict?' organised by the Institution of Electrical Engineers (IEE), was held as part of the Engineering Council's 20/20 Vision programme. It was attended by representatives from the police and security services, publishing companies, civil service, the Church, the law, as well as the engineering profession.

Many of the social and political issues raised by modern engineering systems were debated by delegates who, more importantly, tried to predict and find answers to those to come.

The evolution of computer systems has led to global communication and information capabilities, generally agreed as a potential source of great benefit to mankind. However, such evolution has also led to the vesting of great power in the hands of a few - primarily those who control the substance and flow of information - and the possible abuse of that power is a source of great concern to many professionals.

The ability to copy, record and alter information was also seen by many delegates as a potential, but considerable, risk to the individual. Data integrity is no longer guaranteed.

At the 20/20 meeting, these risks resulted in demands from some for the increased use of encryption as a safe means of communication, but met with warnings from others that encryption poses a possible threat to law enforcement.

The 20/20 Vision forum delegates did agree, however, that privacy might not be the central issue, either for engineers and technologists or for those using the results of their work. The key issues were identified rather as 'authenticity' (who sent the information) and 'integrity' (did that information arrive in the same format as it was despatched).

The forum delegates did identify a number of key messages, including: information service providers must be monitored to ensure that their power is not abused and solutions must be found to the risk of personal data being leaked, unreasonably disclosed or stolen.

A second 20/20 Vision forum led by the IEE sought to identify the social and economic impact of new publishing technology, rather than focus on the technology itself. Traditional publishing houses, libraries, universities, engineering societies, government departments and electronic publishers were all represented to debate 'Electronic publishing - how will it work?' which was chaired by Professor Sir Geoffrey Allen.

The prospect of an early night with a laptop and a good CD-Rom is still remote according to delegates. All agreed that, for the foreseeable future, paper-based and electronic information systems would operate in tandem.

Information overload, a variety of transfer standards, financial constraints, difficulties in information retrieval and the complex issues of copyright all dictate that the paperless society will be some time coming.

It was also agreed that traditional libraries, which have provided a high level of service in the past, would continue to do so as long as paper publications are available. The growth in electronic publications offers libraries new opportunities as information intermediaries which, resources permitting, most will embrace willingly.

HSE strikes gold with agricultural safety video

'No Second Chances', a safety video produced by the Health and Safety Executive (HSE) which gives advice on how to work safely during maintenance or blockage clearing on agricultural machinery, has been awarded the gold medal at an international video competition held in New York.

The video, forming part of a training pack for agricultural colleges in the UK, was produced following an analysis of over 1,000 farming accidents which occurred during machinery maintenance work. The figures included 95 deaths and showed that the majority of accidents involved young people between the ages of 17 to 25 years old.

David Mattey, HSE's Chief Agricultural Inspector commented: "I am delighted that HSE has been recognised for producing this video. It has been one of our major initiatives to drive the safety message across to young farmers, employees and new entrants to the farming industry and the video has been a valuable part of the training package available to colleges and students.

"We will be continuing to produce these effective safetv videos as well as training packages and guidance leaflets in an effort to further reduce the toll of accidents and ill health suffered within the agricultural industry."

Copies of the training pack and video, 'No Second Chances' are available from: **HSE Videos PO Box 35, Wetherby, West Yorkshire, LS23 7EX. Tel: 0845 741 9411.**

Long service certificates

25 Years

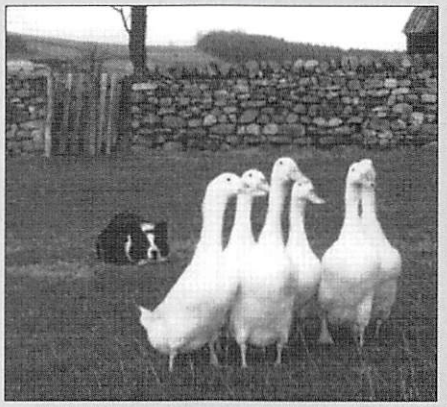
Name	*Grade*	*Mem No*	*Date of Anniversary*
Philip Edwin Alfred **Rickman**	CEng, MIAgrE	3348	23 Jan 1998
George **Key**	AIAgrE	3356	25 Jan 1998
Peter William **Waggitt**	IEng, MIAgrE	3364	25 Jan 1998
Francis John **Butcher**	CEng, MIAgrE	3369	25 Jan 1998
John **Gough**	IEng, MIAgrE	3371	25 Jan 1998
Stuart Mackenzie **Miller**	IEng, MIAgrE	3375	25 Jan 1998
Senathirajah **Sriskandarajah**	EngTech, AMIAgrE	3377	25 Jan 1998
John Vincent **Carvill**	IEng, MIAgrE	3381	25 Jan 1998
Hedley David **Cooper**	IEng, MIAgrE	3382	25 Jan 1998
Geoffrey Russell **Freed**	MIAgrE	3386	25 Jan 1998
Nicholas William **Young**	AIAgrE	3399	25 Jan 1998

Robotic sheepdog booked

A brief report by David Pullen on a recent South East Midlands Branch meeting.

Forty two people attended the annual meeting organised by the South East Midlands Branch on research papers presented by research students from Silsoe Research Institute and Silsoe College. This year the event was held at Silsoe College on 12th January,1998 and papers were given by **James Alford, Agus Mariwiyato, Robert Merrall, Martin Peters, Neil Sumpter and Richard Vaughan.** Subjects included papers on spray deposition, assessment of fruit quality, plastic mulching for maize, variable application of nitrogen and robotic sheepdogs.

The standard of presentation was high and a good evening was had by all. The award for best paper was presented to Richard Vaughan, Silsoe Research Institute for his paper on robotic sheepdogs. He received a book token.



Geese are often used for training sheep dogs. By closing your eyes and using your imagination, you can virtually visualise both the sheep and the robotic dog.

News of Members

Paul Baskerville who works for New Holland is now Area Sales Manager for the Indo China region and is based in Singapore. This is his second spell in Singapore after an absence of 20 years during which time he has had various sales management positions with New Holland covering many of the African and Middle East markets and has been based in the UK and the USA.

David Williams is now a Business Development Specialist working for Citizens Network for Foreign Affairs Inc and based in the Ukraine. He says that he hopes to carry on the existing work of Citizens Network in promoting the use of "western technology and methods" to advance the production of Ukrainian farms and agriculturally based businesses. The CN office is a facilitator which is already working with Cargill, Monsanto, Heinz, AgCo and others to help improve the effectiveness of Ukrainian agri-business.

Richard Boak has recently joined Sir William Halcrow & Partners Ltd, and will be based in their new Crawley office. He is making the move along with about 70 other former employees of the Southern Water Technology Group, under an outsourcing agreement. Richard will be in Halcrow's Water and Environment Department, which undertakes consultancy work in a wide range of fields, including: environmental assessment, environmental protection, groundwater resources and hydrogeology, water supply and waste water engineering. Richard's particular areas of expertise, built up over a 17 year career in the UK and overseas, are hydrogeology, groundwater resources, and overseas rural development. He can be contacted on Tel: 01293 534932 or Fax: 01293 530830.

Rob Causer is on a 3 year contract as Estate Engineer with Rwenzori Tea Company in Uganda, which is partly sponsored by CDC. His responsibilities include: power generation, water supply sanitation, steam management drying (post harvest), vehicle maintenance, factory maintenance, design and construction, fabrication, welding and machine shop development. His work includes project management and dealing with Ugandan contractors. Rob says that he is kept very busy and is finding the work most interesting, and considers himself fortunate in obtaining this position so soon after graduating.

Enoch Armah has been elected as the President of Ghana Agricultural Engineering Students Association (GAESA) for the year 1997/8.

Geoff Freed who emigrated to South Africa in 1976 is now the Managing Director of Kongskilde (SA) which is a subsidiary of Kongskilde Maskinfabrik A/S in Denmark. The company, which employs 33 people, has a turnover of R27 million and is concerned with grain and materials handling, drying for agriculture and industry, and also cultivation equipment.

After being made redundant, **James Turnbull** has set up his own consultancy company, Belmont Management Consultants Limited. James has 24 years experience of agricultural and agri-business in 26 countries throughout Africa, the Middle East, Asia and Eastern Europe, with supervision of contracts in a further 48 countries. Skills include business development, preparation of tenders, negotiation and the management of a wide range of activities and fields covering 230 projects in total. The new company BMC brings together the skills and resources of a group of individuals who have known each other and worked together in teams for many years. This group of highly experienced international consultants collectively provide a powerful capability and track record in the fields of agri-business, trade development and investment promotion. All are selected for their hands on experience of industry in over 100 countries. James can be contacted at 32 Oakley Road, Chinnor, Oxfordshire, OX9 4HB, Tel: 01844 352385 or Fax: 01844 354991.

After spending a year at Silsoe Research Institute, on sabbatical leave from the University of Nairobi's Department of Agricultural Engineering, **Dr P G Kaumbutho** has returned to Kenya with his wife and family. Whilst at Silsoe, Dr Kaumbutho worked on animal welfare research with particular reference to livestock transport. He also worked with the International Development Group on a Rural Transport Project. In addition to his main job, to which he returned (Senior Lecturer in Agricultural Power and

Local methods of transport for chickens and a sheep.

Machinery), he continues to be Executive Co-ordinator of the Kenya Network for Draught Animal Technology (KENDAT). KENDAT is a Kenyan NGO dealing with research and development, dissemination, extension and promotion of draught animal power, including other aspects of mechanising smallholder farms and other business enterprises.

Among various activities in this line, KENDAT is currently working with the Development Unit of the University of Warwick, designing, manufacturing and testing animal powered carts for local production. The DFID funded project is based in Kenya and Uganda. Artisans are trained to manufacture carts and are supported to make a business out of the venture, a means of ensuring sustainability and impact of the project work. Dr Kaumbutho says that since leaving Silsoe Research Institute it has been quite a change, returning from animal welfare concerns of modern 30 tonne transporters on highways, to rural transport problems of poverty and poor infrastructure. Here there is little comfort for animals, and he has become frustrated by the inability to do much to help in the Kenyan situation. He wonders if it is a lack of means, caring or education? (See photographs of methods of transport for chickens and a sheep). Any members with similar mechanisation interests are invited to write or visit Dr Kaumbutho, who can be contacted by telephone or fax: 254-2-766939 and e-mail address: KENDAT@ken.healthnet.org.

David Killer has recently moved from Wales to Scotland as Head of Forestry Civil Engineering. This new unit will manage all Forest Enterprise's civil engineering work with Area Civil Engineers offices across the country and a Head Office based in Peebles. His background of civil engineering in the private and public sector and more recently as Harvesting and Marketing Manager for Forest Enterprise (Wales) will provide a good base for developing a civil engineering service to the forest industry.

Mike von Kaufmann has resigned from Booker Tate and Zambia Sugar to start his own consulting business based in Durban covering mainly Southern Africa. He will be specialising in the mechanisation of sugar cane, harvesting, haulage, land development and preparation for irrigated sugar cane. Mike's address is PO Box 1943, Umhalanga Rocks, 4320, South Africa. Tel/fax: 27 031 561 6094.

Ken Hopkins and **Lloyd Mwale** both still work with Zambia Sugar. Ken is Project Manager for the rehabilitation of the factory and is at present trying to install two vertical crystallisers and a continuous pan. Lloyd is doing a management trainee programme to take over the post of Agricultural Engineer.

Louis Muswema has moved from Zambia to Namibia to take up a new appointment at Ogongo Agricultural College as an Agricultural Training Officer. His terms of reference include delivering a course of lectures on agricultural mechanisation including tractors and animal traction, contributing to the process of design and delivery of short specialised training courses and participating in the national agricultural research programme. The appointment is for a period of 2 years.

L A G Wedd has recently retired from the African Highlands Produce Co (James Finlay) and is now working from home as a consultant to the tea industry. He will also do alternative Agricultural Engineering work if the opportunity arises.

Dr Jim Greatorix left Silsoe Research Institute in 1996 to take up a one year guest researcher's appointment in the Institute of Agricultural Engineering, at the Agricultural University of Norway. During this period he was involved with the production and testing of a new type of organo-mineral fertiliser based on recycled organic waste. The process was developed in collaboration with a company called Agronova AS. Jim says that having found the natives to be friendly, he took the opportunity to apply to the Research Council of Norway for a 2 year project exploring the possibilities of using the Agronova fertiliser in the horticulture sector. He began work on this project in January and he travels to England on a fairly regular basis. This is a collaborative project with ADAS and is supported by an EU grant and involves carrying out a user acceptance survey of UK farmers to organo-mineral fertilisers. Jim says that there is always something to look forward to in Scandinavia and he enjoys the climate. He is also looking forward to the AgEng98 conference in Oslo, where he hopes to meet many old friends from his Silsoe days.

AAWC

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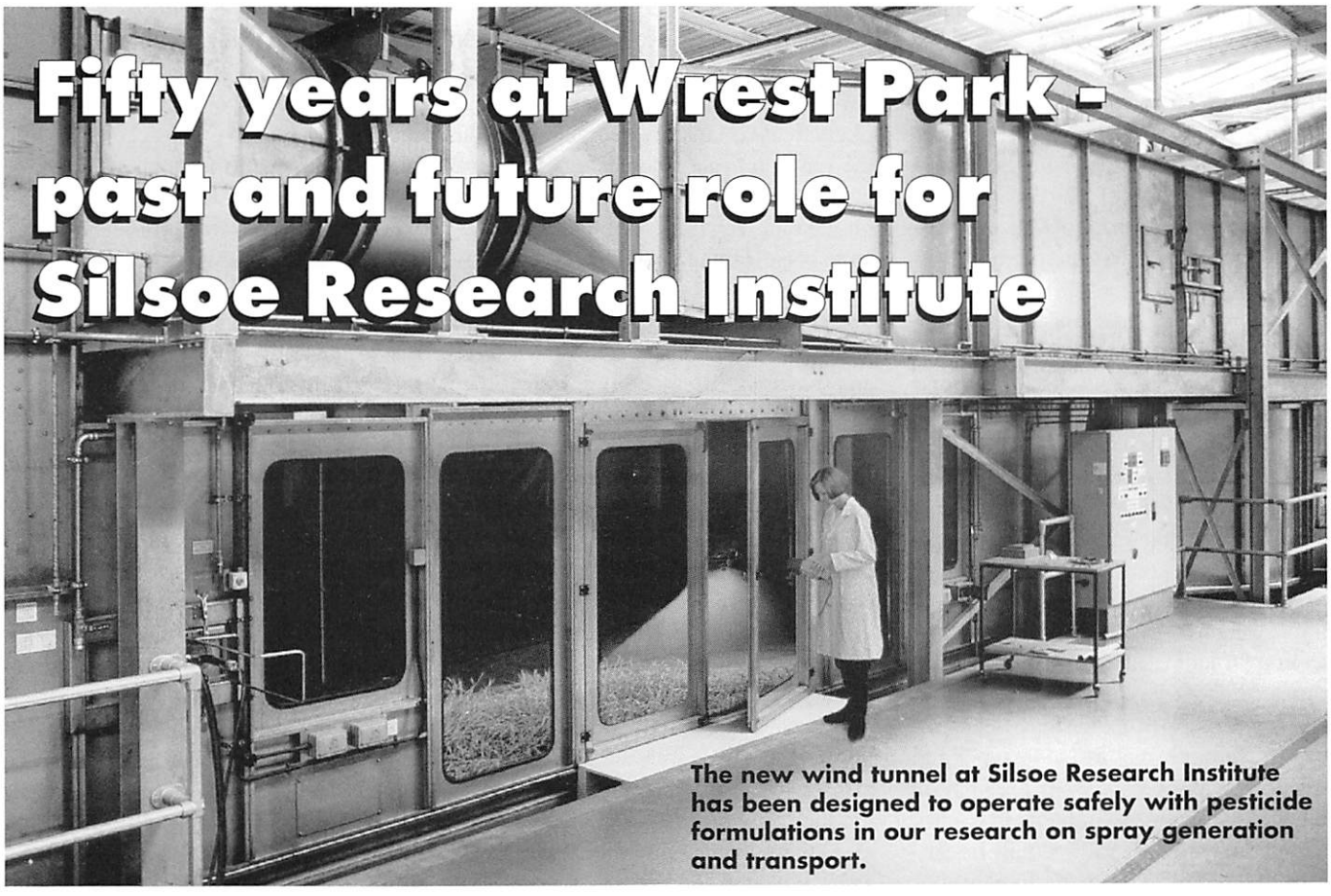
Fifty years at Wrest Park - past and future role for Silsoe Research Institute



The new wind tunnel at Silsoe Research Institute has been designed to operate safely with pesticide formulations in our research on spray generation and transport.

In 1997, Silsoe Research Institute (SRI) celebrated 50 years at Wrest Park in Bedfordshire. In this paper, I want to look briefly at the Institute's history and achievements over that period, and go on to show how engineering research still has a great deal to offer the agri-food industries.

Brian J Legg

Early history of the Institute

Our history began in 1924 at Oxford, when the Ministry of Agriculture Fisheries & Food (MAFF) realised that the tractor had more long term potential than the horse, and set up the Agricultural Engineering Research Institute. This was part of the university, but funded by MAFF.

Professor Brian J Legg, FIAgrE, is President Elect of the Institution of Agricultural Engineers. As Director of Silsoe Research Institute, he presented this paper on 9th October 1997 at Wrest Park to colleagues and guests from industry at an event organised to celebrate the fiftieth anniversary of the Institute's arrival at Silsoe.

Its early existence was precarious, especially when its first Director, B. J. Owen, was imprisoned for forgery and fraud in 1931, leaving his staff confused and demoralised (Harrison, 1994). Captain Owen had had a successful career in the Royal Engineers during World War I, and later in charge of a wartime Food Production Scheme, before joining MAFF in 1918 (Anon., 1924). Unfortunately, he found it too easy to 'obfuscate the difference between accounts and patents belonging to himself, his Institute and the University' (Harrison, 1994).

The Director's dishonesty was not the only problem. The Institute's position at Oxford but under MAFF control led during the 1930s to financial difficulties with a very familiar ring. The Ministry controlled the research, with an emphasis on short-term applied projects. Changes to policy led to 'forced displacements' of staff, and Oxford told MAFF that 'a university could not engage staff on a monthly basis like domestic servants' (Harrison, 1994).

During World War II, the drive for home food production led to a move to Askham Bryan in Yorkshire and a major expansion from 23 to (eventually) 150 staff (Cox, 1984). Then in 1947, the Wrest Park estate was chosen as a permanent home for the National Institute of Agricultural Engineering (NIAE). The advantages of the site which determined its original choice are still relevant: it is close to important arable farming areas of Britain, with a mixture of sandy and clay soils, and has good access to London. We have a 99 year lease and fully intend to see out its last 49 years.

Fifty years of achievement

The past fifty years have been the heyday of agricultural engineering. While research in agronomy has led to a doubling of yields, engineering and mechanisation have led to a 30-fold increase in labour productivity per tonne of crop. The Institute, whether as NIAE or later as AFRC Engineering (1986) and Silsoe Research Institute (since 1990), has

played a major role in this achievement. Here are a few examples.

Our early research on tractors included destructive testing of tractors allowed to roll down Ivinghoe Beacon, and indeed driver health and safety has been an important topic for us. Extensive ergonomics research in the 1970s and early 1980s provided understanding of the effects of design factors on driver health and performance, and underpinned improvements introduced by most manufacturers. Studies of tractor access, noise and seat design led to improved tractor cabs. Ride vibration research showed that work rates were higher if discomfort was reduced. Work on front axle and cab suspensions was taken up by tractor manufacturers. We contributed significantly to test procedures for Roll Over Protection Structures and Falling Object Protection Structures, and to standards referring to tractor vibration.

Tractor performance has been improved through our work on tyres and traction. More recently our research on integrated tractor and implement control showed how work rates could be improved by 12%. This work, like most of our tractor research, was initially funded by MAFF but is now being supported by a UK manufacturer for commercial production.

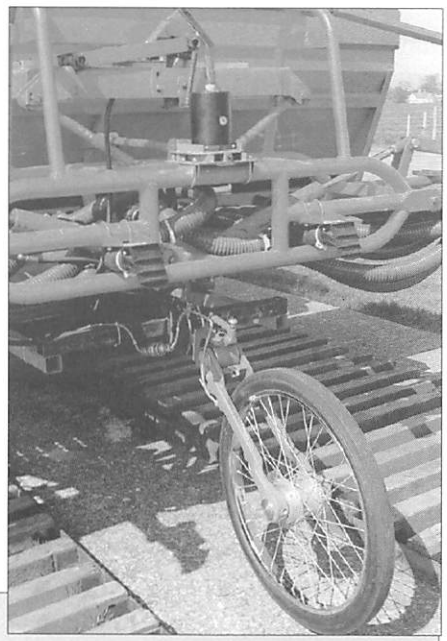
We have made major innovations in cultivation equipment including the tillage train and the Dynadrive, winner of an RASE Silver Medal in 1982 and manufactured in both UK and under licence in USA. Our earlier contributions to crop protection were practical developments such as orchard sprayers to improve tree coverage and boom suspension to provide more effective spray application. The majority of sprayers on the European market now use suspensions based on principles established here. More recently, we have developed the patch sprayer which won the Archimedes Award in 1992 as the development most likely to have a major positive impact on the environment. Increasingly, we are taking a rigorous scientific approach to understanding spray application. We have been leading contributors to standards ensuring that sprayer design, operation and test procedures are based on scientific understanding of spray generation and transport. By modelling spray drift, we have shown how to estimate and reduce the risk of off-target contamination.

Notable examples of the Institute's contributions to crop harvesting include sugar beet cleaning and topping, blackcurrant harvesting, and the grass mower conditioner, which gave up to 30% faster swath drying and patents which, during their lifetime, were our most successful to date, with 19 international licensees. This innovation well illustrates the timelag between research and commercial availability: the successful commercial product only became available 8 years after the first patents were granted in 1970, but now all conditioners made in the UK use the technology in those patents. More recently, our stripper harvester increases grain harvesting speeds by 50% and has won two Queen's Awards. The stripping principle has also been used to develop a hand-controlled harvester for rice suitable for manufacture and use in developing countries.

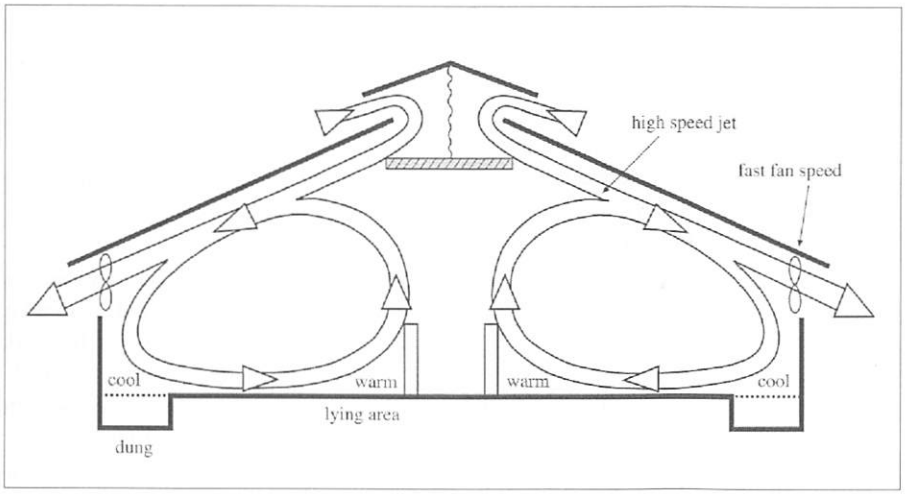
Turning to post-harvest operations, the Institute has a long-standing reputation for its research on grain drying, while in recent years we have seen our novel decorticator for fibre removal from linseed straw move into commercial operation and win a 1997 Science into Practice Award for its operator Robin Appel.

Horticulture and field crops have not been neglected, with an apple grader, and later a potato grader using image analysis to measure size and shape, which was the first machine to grade vegetables with high resolution inspection of the whole surface in colour at 40 objects per second. Both graders are in commercial use.

The Institute did work on the handling of livestock wastes at Askham Bryan but the main emphasis in its early years was on mechanisation for crop production. As the agricultural labour force was reduced, however, it became necessary to improve the productivity and working conditions of people in livestock production, and we took up research on livestock handling and monitoring in the 1960s (Cox, 1984). Since then, engineering for animal production has become increasingly important. A substantial programme on waste handling and treatment has underpinned MAFF's concern to protect the environment and reduce pollution from farm sources. We did pioneering work on automatic identification of individual animals using a collar-borne transponder in



The twin-link boom suspension system developed at SRI on a fertiliser spreader. Inset shows the suspension instrumented for performance evaluation.

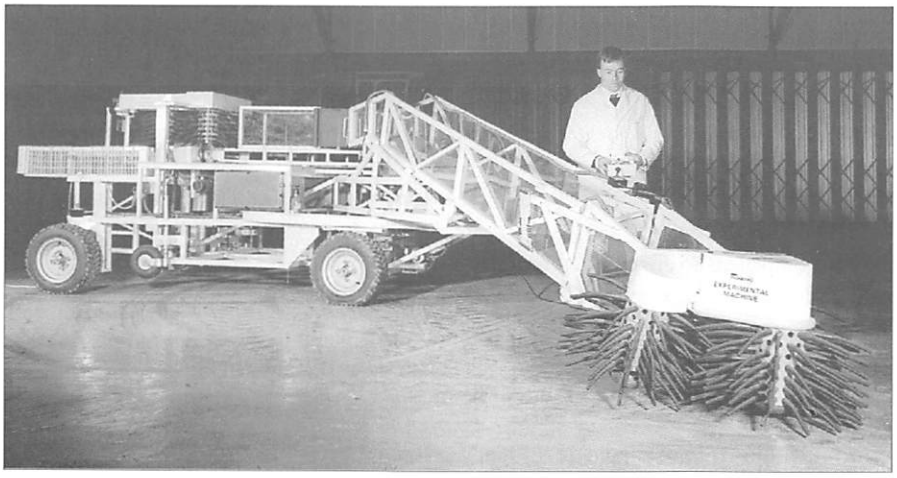


The high speed jet ventilation system for piggeries, developed at SRI and now widely used, established a cool dunging area. The air flow as it approaches this area is relatively fast, cooling the pigs. The airflow reaching the lying area has lost speed and gained heat from the pigs, so feels relatively warm.

the mid-1970s, and this is now the basis for all subsequent livestock control and monitoring, such as controlled concentrate feeders and milking parlour monitoring. We designed the high speed jet ventilation system, to give good temperature distribution in intensive piggeries, and cleaner pigs. This is now widely used for both pigs and poultry, with at least 6 manufacturers and 1000 installations.

With increasing public concern about animal welfare, MAFF has funded research on animal handling and transport. The Institute's highly innovative poultry harvester was designed to collect broilers gently and lift them into crates with much less stress than is engendered by human collectors. Here again, commercial take-up has required a full 10 years since the patent was granted, but now the machine is being manufactured and marketed by 4 companies world-wide. Research on poultry transport has been carried out with partners in an animal research institute (Roslin), a university (University of Nottingham Department of Civil Engineering) and three commercial companies. This has resulted in new vehicle ventilation systems that can maintain acceptable thermal environments for birds. Both MAFF and the EC have funded Institute research on animal responses to the environments experienced during journeys, to provide a scientific basis for proposed legislation and Codes of Practice.

This brief account has inevitably left out many other Institute achievements, for example research on building design, environment control and how to reduce wind damage. The Research Councils who have supported us (the Agricultural and Food Research Council and then the Biotechnology and Biological Sciences Research Council), MAFF and industry have shown foresight in investing in engineering for agriculture at Silsoe over the last 50 years. The results show this has been money well spent. But there are still further gains to be obtained. The problems have not all been solved, and research is still needed. So now I want to look at Silsoe Research Institute's role for the next 49 years.



The Institute's innovative poultry harvester can collect broilers gently and lift them into crates, eliminating the stress (to both birds and man) of manual collection.

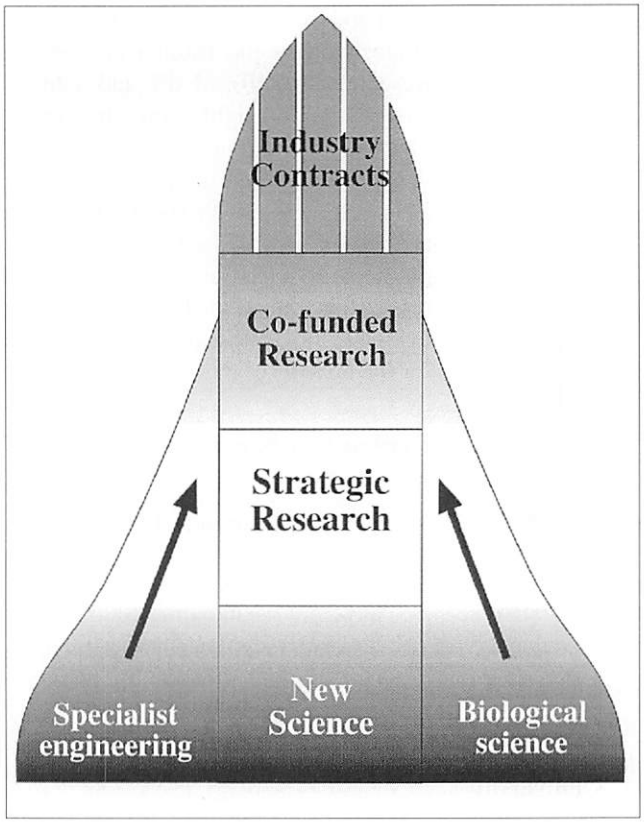
Problems for the agri-food industry

The pressures on the agri-food industries are greater than ever before. There are more people to feed and consumer expectations are continually rising, encouraged by media publicity and competitive standard-setting activity by the large retailers.

The issues include continuity and variety of supply, food safety, visual and sensory quality, and freedom from chemical residues or other harmful components, improved animal welfare, protection of the environment, and more public access to the countryside where farmers earn their living. In addition to all these demands, we all expect food to remain as cheap as it is at present. Whereas 50 years ago households had to spend about a third of their income on buying food they needed, the proportion today is less than 12 per cent (Slater, 1991).

The challenge for the agri-food industry is thus to develop and implement field-to-fork systems that guarantee delivery of safe, high quality food with due regard for animal welfare and the environment. What is engineering's role in this?

There is no doubt that engineering science and technology has been moving fast, and over UK industry as a whole this is acknowledged and the benefits have been appreciated. The government Office of Science and Technology conducted a Technology Foresight exercise in the early 1990s, and the results confirmed the importance of engineering. In this exercise, which initiated the continuing Foresight Programme, all industries and academia were asked to identify the areas of science and technology most likely to provide major advantages over the next decade. Within the agri-food industry, participants emphasised benefits from biology and chemistry, which certainly have great potential. But overall,



Silsoe Research Institute will integrate its BBSRC-funded science, its strategic research for MAFF and industry, and its applied research on shorter-term problems, so that all customers can benefit from our well-established expertise and our network of collaborators.

engineering topics dominated the list. Out of 27 key national priorities, 14 were engineering and mathematics, 6 were engineering with other sciences, 4 were biology and chemistry, and 3 were social science such as management.

The Institute's role is therefore to work with biologists and agricultural scientists to ensure that our industries can benefit from engineering, just as others do. After all, the agri-food industry not only grows raw materials but also harvests, handles, stores, transports, processes, packages, and delivers them to the consumer in perfect condition. For each of these operations it depends on engineering solutions. For the overall system, optimisation is needed to ensure efficiency. But the research funders for agri-industry tend to focus so hard on biology that the need for engineering is either over-looked, or considered to be someone else's responsibility. In fact, we know that engineering advances don't happen automatically, and the history of our achievements demonstrates that both long-term research funding and careful work with commercial companies to overcome problems are needed before the benefits of engineering can be realised.

Engineering science and technology are continuing to develop at an awesome pace and have the power to revolutionise the agri-food industry. Some of the key topics from Foresight are:
automation;
communication with machines;
sensors and sensory information processing;
software engineering;
information management;
modelling and simulation;
clean processing technology;
process engineering and control;
materials and biomaterials;
materials processing technology.

Many of these depend upon the power of computers and microprocessors, and this technology is moving so fast that for a given price the power doubles and the size halves every 18 months. Research using the engineering skills listed above will allow us to simulate complex processes, sense, monitor and interpret qualities or the state of a process, develop intelligent control, and provide management information - but only if the researchers are well-qualified engineers who also know and care about the agri-food industry, and understand the complexities of the biological products and processes it deals with.

The role of Silsoe Research Institute

I believe our role is to ensure that the agri-food industry gains maximum benefit from advances in engineering science. We are here to bridge the gap between biological complexity and engineering technology.

To fulfil this role, we have developed a group of engineers and scientists who are technically world class. They have:

- the right technology
  - or access to it wherever it may be found;
- the right connections
  - good partnerships with individual companies
  - good working relationships with other scientists, especially biologists;
- the right attitudes
  - a determination to deliver their innovations through to the market place, even if this takes 8 or 10 years.

There is a risk, however, that the pick-and-mix free market approach to research, much favoured by our last Government, has placed too much value on the technology visible in the shop window, and too little value on the experienced people, with their network of support relationships, who are responsible for the ultimate delivery of the benefits.

The future

The illustration shows my model for Silsoe Research Institute's future activity. We aim to integrate our new science, our strategic research which aims to provide the knowledge industry will need over the next decade or so, and our co-funded and contract applied research, which solves shorter-term problems. Thus, when industry or government funds research at the Institute, whether it is for £10k, £50k or £200k, they will not only receive good value for the money spent, but will also benefit from the underlying wealth of knowledge and experience, and the opportunity to return again and again to find new solutions.

Customers who return will notice changes at Wrest Park; we are currently making a major capital investment in our site, with new research facilities and laboratory buildings. Yes - we are looking forward with enthusiasm to the next 49 years!

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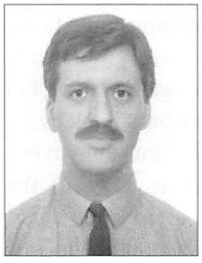
New and used farm buildings - what is the difference?

Richard W Langley



Within the present economic climate, farmers and growers are constantly aware of the need to reduce fixed costs to maintain a profitable business. At the same time, the need to expand and diversify is ever present. When considering a building project, the prices advertised for used building packages appear on the surface to be an economical way to erect a building at minimal cost. However, is this always the case?

The alternatives: 'new' or 'used'

For a valid comparison between new or used buildings, it is necessary to set out the alternatives, state what is included and select the same specification of building package. Therefore, a basic package of frame, fibre cement sheets, roof lights and rainwater goods was selected for a building measuring 18 x 33 x 4 m which is a common off-the-shelf size (Hardwick, 1997). The remainder of materials and labour required to finish the building are the same whether choosing a new or used basic package.

Used buildings advertised by dealers are generally redundant industrial buildings. Some agricultural buildings are dismantled but they are generally of too poor standard for resale due to the quality of material and construction, and lack of adequate maintenance. Those agricultural buildings that are sold, often pass between farmers in the locality of the farm for DIY dismantle and re-build projects. The existence of facts and figures for these transactions is not easily attainable; therefore, only buildings sold by recognised dealers are considered. The contents and condition of parts included in new and used building packages are illustrated in *Table 1*.

New buildings have the advantage of being manufactured to present day standards, BS5502 or BS5950

Factors affecting the choice between 'new' or 'used'

1. Local Authority Planning Control

In our example, the building is over 465 m^2 and therefore requires full planning permission. Before beginning the development it is necessary to apply in writing to the Local Authority Planning Department with details of the proposed siting, size and external appearance of the building project. The planning departments are very conscious of the effect a large building can have on its surroundings, especially green field sites, and consequently have great control over the size, colour and finish of a proposed building.

A used building obviously is 'as dismantled' and therefore what may have been a totally acceptable colour and finish in one area may be completely unsuitable in another. The planning officers' opinions are totally subjective often with no written guidelines for clarification, and early consultation could save the cost and frustration of purchasing an unsuitable building. The option of changing the colour and finish of the sheeting material of a used building to overcome planning restraints is covered from a financial standpoint in *Table 2*.

The choice of a new building allows the developer to consult with the authorities at an early stage with relevant brochures and material samples; this would appear a less frustrating option.

2. Suitability of materials to intended building use

The intended use of the building has a significant bearing on the choice of new

Table 1 Basic building package.

New	*Used*
Bare cold rolled steel framework sections, sand or bead blasted and finished with factory applied zinc - phosphate based primer and topcoat. Complete set of bolts and fixtures.	Steel framework as dismantled. Reclaimed fixings suitable for re-use, approximately 50% of total required.
Fibre cement corrugated sheets in chosen colour. Translucent rooflight sheets. Complete set of roof fixings and sealants.	Fibre cement or steel/aluminium corrugated sheets, colour, finish and condition as dismantled. Missing sheets due to breakage/damage made up from other used sheets. No transparent sheets (transparent PVC sheets not suitable for re-use as they become brittle in use and almost always break on dismantling). Roof fixings as recovered, approximately 50% of total required.
Rainwater goods, gutters downpipes to around level.	No rainwater goods.

Richard Langley, MIAgrE, is Senior Lecturer in Agricultural Engineering, Department of Engineering Technology, Writtle College, Chelmsford, Essex CM1 3RR. He supervised the BEng project by Richard Hardwick and summarises the results of the investigation in this article.

or used. As the majority of used buildings are of the industrial type, most utilise steel or aluminium profiled cladding. Steel and aluminium are lightweight and require less support (fewer purlins) but, when used in an agricultural building especially as a roofing material, may have the inherent problems outlined as follows.

Table 2 Comparison of purchase price (SAC, 1996).

New		*Used*	
18 x 33 x 4 m kit package. Steel frame shot blasted and finished in 2 coats Zinc Phosphate based paint. Complete set of bolts. Fibre cement corrugated sheets. Transparent rooflights (2/bay). All fixings and sealant. PVC rainwater goods to ground level.		18 x 33 x 4 m kit package. Steel frame as dismantled. 50% of fixing bolts. Fibre cement sheets (if available). 50% of fixings. **SUBTOTAL** **Extras required to complete package to as new** Beadblast all steelwork. Two coats Zinc Phosphate based paint. 50% of bolts. Transparent rooflights (2/bay) 50% of roof fixings. PVC rainwater goods to ground level. **SUBTOTAL**	 **£8,000.00** = £13.46/m^2 £600.00 £525.00 £250.00 £934.74 £163.80 £832.02 **£3,305.56**
TOTAL	**£10,800** = £18.18/m^2	**TOTAL**	**£11,305.56** = £19.03/m^2
		Alternatively, cost to replace roof sheets with fibre cement	
		Cost of sheets, fixtures and fittings (new) Allowance for old sheets. **EXTRA COST** **TOTAL**	£3,250.00 £1,000.00 **£2,250.00** **£13,555.56** = £22.82/m^2

(a) *Stock Buildings*: The atmosphere inside a stock building is a mixture of elements, comprising carbon dioxide, methane, hydrogen sulphide and ammonia. When associated with the high levels of condensation present, the result of this highly corrosive atmosphere on steel/aluminium sheets in worst cases can be a reduction in useful life of from 3 to 8 years. (Barnes & Mander, 1991).

In windy conditions, the fixing holes in steel/aluminium sheets can become elongated, allowing movement of the sheets which can lead to noise levels inside the building which will unsettle stock. This can lead to stress and consequential lower production, i.e. of milk yield, weight gain (BS5502, 1990). In any case, during heavy rain, steel/aluminium sheeting is very noisy which will produce the stress problems as above.

(b) *Crop Storage*: Harvested crops continue to respire when in storage, and a by-product of this respiration is moist air. Moist air is also produced when the moisture content of combinable crops is being reduced by drying. Moist air coming into contact with a steel/aluminium roof may condense and form water droplets. If the water droplets are allowed to contact the stored crop in large enough quantities, spoilage will occur.

Selecting a new building package allows the construction material to be matched to the intended use of the building. From the above, the unsuitability of steel/aluminium for the stated cases can be overcome by employing fibre cement sheeting. This sheeting has the ability to 'breathe', allowing moist air to permeate to the outside, thus reducing condensation and enabling the material to resist corrosion even in the harshest conditions. The thickness and construction of fibre cement sheets reduces the internal noise levels from heavy rain by absorbing the sound, vastly reducing the stress levels to livestock.

Costs

1. Comparison of purchase price

From *Table 2*, it can be seen that after adding the extra components and renovating the used building to the completeness and standard of finish of a new building, the used building is 4% more expensive than new. The cost of the used building could be reduced by not blasting and painting, but this only reduces the used building to 6% below new. If the steelwork is in perfect condition, this may be a suitable option but the quality and robustness of finish after blasting and painting cannot be overlooked.

2. Capital allowance

The Inland Revenue allows buildings to be written down at 4% per year over a 25 year period. There are no incentives or extra allowances for used buildings over new (Nix, 1996).

3. Farm value

A well designed building or group of buildings that enhance the appearance of the farmstead, in most people's opinion, improve the marketability and consequent value of the farm. Choosing new building packages would allow a planned expansion of buildings of the same type, size and style which would enhance the farmstead. The choice of used buildings, however, is very much a matter of what is available at the time of the project. In a stand-alone situation, the type, size and style are of little importance, provided they fit their surroundings from an aesthetic point of view. But when used in a group situation, unless one was very fortunate in the type, size and style of build-

ings available, the outcome could be a mismatched 'eyesore'.

Lifespan

Most steel framed agricultural buildings have a design life of 20 years (BS5502 Class 2). This is a theoretical figure that allows a standard of the design and build quality to be regulated. Many steel framed buildings are still perfectly serviceable after 40-50 years or more. The extra lifespan achievable, from say, a 20 year old building, depends on a number of factors. The previous use of the building will determine the condition of the frame and component parts. A building that has been subjected to an environment of high moisture, chemical or physical impact needs careful scrutiny before it is considered. Renovation and repair of the steel frame should not be carried out on the 'cheap' if a maximum extended life is expected. Bead blasting and repainting, with a zinc-phosphate based paint, will bring the steelwork back to 'as new' condition. Careful dismantling especially of cladding, not only will ensure a maximum extended life, but the re-usability of the material.

Conclusions

1. Many used steel framed buildings are advertised through farming publications at what appear very reasonable prices. Unfortunately, any financial saving in purchase price is eroded when all the factors involved in erecting a used building are considered.
2. Local authorities have become more aware of the need to protect the visual environment of the countryside. Used buildings are 'as dismantled', and the colour and finish of a building that suited one area may be totally unsuitable in another. The cost of changing the cladding material pushes the used building price well above that of a new building.
3. The option of consulting planners with new material samples and brochures at an early stage in the procedure appears a more efficient method to gain permission for a building project.
4. The nature of used buildings results in a certain amount of corrosion to steelwork and fixings. Even with the greatest care in dismantling the building frame, it will require some refurbishment and a number of component parts (e.g. transparent roof sheets) will have to be replaced to bring the standard of finish and completeness of the building up to that of a new building. When the cost of replacement components and refurbishment of the steel frame is added to the purchase price, the overall cost is higher than new. Therefore, this aspect offers no advantage.
6. The value and marketability of a farm are enhanced by well-designed, aesthetically pleasing buildings.
7. The size, style and colour of a used building is determined by availability. In a stand-alone situation, these factors are reasonably unimportant but, when considering a group of buildings, the result could be a mismatched 'eyesore' that would detract from farm value and marketability.
8. The extended lifespan of a used building is very difficult to predict but a well-renovated building with known history should essentially give as good a life to the user as a new building. As most used buildings are former industrial buildings, they are consequently of a better construction (higher standard) than agricultural buildings of similar age.
9. From this study, there appears no apparent reason, other than to satisfy one's own environmental conscience in re-cycling materials, to purchase a used steel framed building.

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Branch Diary

South East Midlands Branch

Monday, 20th April at 7.30pm

Silsoe Research Institute, Conference Room

Electronic Diesel Control

by Matthew Markowski, Bosch Ltd

New Event

Friday, 15th May at 2.00pm

Visit to British Antarctic Survey, Cambridge

Followed by meal.

Contact Secretary by 21st April, 1998

Monday, 1st June in the evening

Technical Visit to Jack Ashurst Ltd, Biggleswade

Contact Secretary by 11th May, 1998

New Venue

Barbeque

In aid of Mike Dwyer Memorial Fund

Details will be circulated to members closer to the event

Hon Sec: David Pullen Tel: 01525 863038

Stick by me

Permabond is prepared to give away free copies of a new selector chart as an easy hang-on-the-wall reference to a comprehensive range of its adhesive products.

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This is a positive aid to identifying which of Permabond's impressive catalogue of adhesives - covering single and two-part epoxies, acrylics and cyanoacrylates, plus specialist compounds for metal repairs or gaskets - is most suited to your next important joining job.

Technical contact: **Verity Lewsey, Permabond, Woodside Road, Eastleigh, Hampshire S050 4EX, tel. 01703 629628.**

Tractor market

Following a Decision of the EC Commission permitting the analysis of annual machinery sales data one year in arrears, the AEA have released an analysis of UK tractor registrations for 1996 showing company breakdown for the major brands.

The data analysed are tractor units registered for road use under the Department of Transport body code 'agricultural tractor'. Almost all tractors sold into agriculture are registered. However, it should be noted that small tractors (e.g. below 30 kW) are sold into various markets and not all are registered.

UK Agricultural Tractor Registrations System, calendar year 1996, by manufacturer.

Manufacturer	*Quantity*	*Percent*
New Holland	4471	22.6
AGCO (Massey Ferguson)	3966	20.0
John Deere	3846	19.4
Case	3322	16.8
Renault	736	3.7
Kubota	695	3.5
JCB Landpower	584	3.0
Valmet	305	1.5
Other	1859	9.4
Total	19784	

The number of agricultural tractors registered in 1997 was 15,272, a decline of 18% on 1996 levels. In addition 1,022 compact tractors (-12.6%) were registered giving a grand total of 16,294 units (-17.6%).

The total power sold into the agricultural market was 1,232,250 kW (-16.3%) reflecting a 2.1 % increase in the average size of agricultural tractor units to 84.2 kW. All power ranges showed a decrease on the previous year but the lowest fall was seen amongst the higher power tractors.

Dramatic reduction in road deaths

A Britain of the future with a dramatic reduction in road deaths thanks to new electronic and information technology is envisaged in a new report published today by the Institution of Civil Engineers (ICE) on behalf of the Engineering Council.

The report, *A Vision for Transport 2020,* sets out a comprehensive strategy for the future of the country's transport; in particular, it recommends the establishment of an 'intelligent transport system' using the latest developments in electronic and information technology that could transform many current road transport problems, thereby:

- saving thousands of lives;
- controlling traffic congestion and the impact on the environment;
- doubling the capacity of main roads without the need for new construction;
- helping drivers navigate the road system;
- providing travel information for pedestrians and motorists.

A first step is the introduction of electronic traffic calming on vehicles to enforce safe speeds. Electronic collision avoidance systems and pedestrian safety devices in vehicles such as pedestrian air bags could enhance safety further. These improvements could greatly reduce the dangers both for motorists and for people walking and cycling.

For those who rely on walking, improved security would be provided by personal distress beacons with video linkage. This will be of particular value to women, many of whom are afraid to travel at certain times of day owing to concerns about personal security.

The report stresses that there is no single solution for transport, and that a combination of land use and lifestyle changes, new technology and investment in transport systems will be required. The need of individual people for a fulfilled life, and for a safe, attractive and unpolluted environment, must form the overall objective.

The report also predicts the growth of tele-travel (including tele-shopping and teleworking) but warns that the effect could be to disperse the population into rural areas and increase dependency on vehicles.

Other recommendations include:

- changed lifestyle and land use patterns to provide both people and industry with shorter travel distances and a wider choice of environmentally friendly modes of travel;
- a railway renaissance, including the construction of a national high speed freight grid with road-rail interchanges every 75 miles, and major improvements to passenger rail services including provision for people with mobility impairment;
- pipelines - to expand the use of this form of transport and to develop the possibility of a blue skies solution to the freight problem through 'freight capsule' transport, with containerised goods carried in capsules in underground pipelines;
- air travel - to reduce door-to-door journey times by improving surface access and terminal facilities, and to introduce new technology to reduce environmental impact and energy consumption of air travel;
- water - to exploit the opportunities presented by high-speed craft for the movement of passengers and high value goods, which will require improvements to port facilities and supporting road and rail links;
- motor vehicles - the introduction of energy efficient, low pollution, lightweight, low noise vehicles using fuel cell propulsion;
- walking and cycling - to recognise that walking forms the basis of the transport system, and to improve safety and facilities for both of these.

The report also recommends:

- the development of a seamless transport system through equal regulation, safety and enviromnental standards across different modes of transport;
- the introduction of a national transport information system for freight and passenger travel, so as to enable easier planning of journeys by any mode of transport;
- and the promotion of a sustainable transport hierarchy.

Goldoni in Scotland

A 25-strong sales team from the G. Reekie Group, vehicle and equipment distributors and plant hirers, descended on the 120 ha farm and woodland at Cluny Clays Shooting and Archery Centre near Kirkcaldy recently to try out the latest Italian imports. The company has become the exclusive Scottish distributors of the new Goldoni compact tractor range whose versatility allows it to cope with everything from fertilising and grass cutting to snow clearing.

The target they were aiming for had nothing to do with shooting or archery, however. It was to train the sales team in handling and demonstrating the new Italian range which has already created considerable interest among farmers, contractors, horticulturalists, estate owners, landscapers, golf course and playing field groundsmen.

The flexible 20 - 50 kW tractors are multi-functional, using attachments from lifting equipment, seeders and fertilisers to snow sweepers. The lightweight IDEA

The Goldoni Idea (left) and Star take centre stage at Cluny Clays.

model which was originally developed for specialist work in vineyards, orchards, estates and landscaping has a tight-turning radius, compact dimensions and remarkably clear differential span, enhance the multi-functional design. The IDEA has three bladed, mid-mounted mower matched with a high capacity rear grass collector for perfect and precise grass-cutting.

The light and easy to use tractor is well suited for use in parks, sport turf areas, public gardens and golf courses. When equipped with turf tyres, it will not damage the grass or compact the soil.

The STAR series has front power take off, position and draft controlled hydraulic hitch and double acting hydraulic valves and is designed for working in golf courses and parks. With excellent manouevrability and extreme compact dimensions, the STAR gives high quality and precise work. The light steering radius, short wheel base and ideal distribution of weight allows superb performance in a wide range of specialised agricultural applications.

The IDRO 2804 is a front mounted mower specially designed to satisfy the demands of professional groundskeepers. It has a high standard of efficiency and productivity and can cover a work area of 7000/8000 sq. m. per hour. With a mechanical differential lock, excellent weight distribution and a front lift system equipped with a hydraulic weight transfer valve, the IDRO is a very stable machine, able to work on hillsides and slopes. The IDRO mower deck can operate on uneven ground because of its hydraulic motor instead of the traditional shaft drive transmission. It tilts back for easy and quick maintenance.

The EURO RS series is ideal for work on hillsides and narrow areas. With four-wheel drive and front steering, each model can be equipped with a rotary cultivator, trailer and attachments to seed and fertilise.

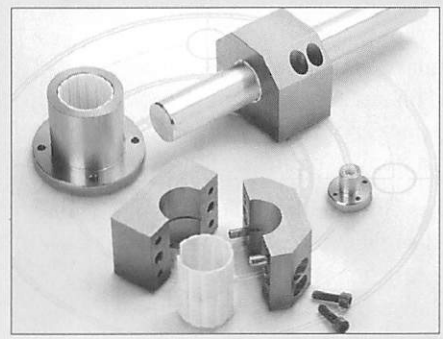
All the tractors are fitted with EEC homologated protection frames (ROPS) to protect the operator in any circumstances.

"The Goldoni came through with flying colours", said John Brown, Reekie Sales Manager for Municipal Related Products. "It's versatility in allowing the operator to perform several functions at once including lifting, transporting and digging, as well as its price, marks it as a winner for all kinds of agricultural, landscaping, groundkeeping and horticultural uses." The G. Reekie Group has branches in Cupar, Stirling, Aberdeen, Perth, Macmerry and Coldstream and is supported by a 50 strong mobile service force.

Contact: **John Brown, Reekie Sales Manager for Municipal Related Products on 01738 622471.**

Self lubricating and maintenance-free

igus (UK) Ltd have developed a new a new type of linear plain bearing for their DryLin[R] range. Rolling elements are replaced by self-lubricating and maintenance-free products. A ribbed sliding film is mechanically located into an anodised aluminium housing. Compared with conventional press-fit bushes, the igiidur sliding film principle offers a number of benefits and advantages such as secure con-



DryLin[R] linear bearing with low-friction iglidur J film.

nection of parts, higher operating temperatures, easy assembly, improved heat expansion, rapid and easy change of inner bearings.

The replaceable sliding film is made from the iglidur 'J' low-friction bearing material which has proved to be more resistant to wear than regular linear bearings. Self-adjusting linear bearings compensate for errors of alignment. The greater surface area can take higher forces than part contact support and so gives up to 10 times higher load capacity. Expensive hardened and grounded shafts are not always necessary. In many instances more cost-effective tensional 'soft shafts' or even aluminium shafts can be used.

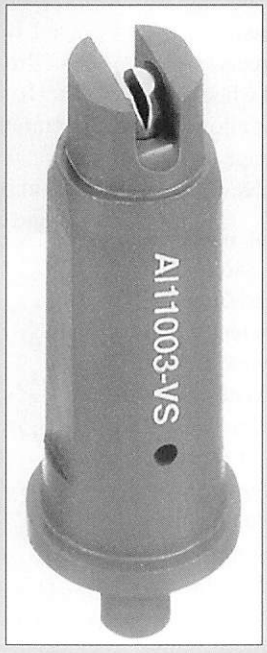
igus research and development has expanded their linear bearing range which now includes flange bearings and split anodised aluminium housings. As the shafts do not need to be removed, the use of split housings considerably shortens assembly time.

igus DryLin[R] Mini Bearings are produced for shaft diameters of 6 mm, 8 mm and 10 mm, and a development programme is nearing completion for imperial sizes of half inch to 2 inches.

Contact: **igus (UK) Ltd, 10 Newton Close, Drayton Fields, Daventry, Northants NN11 5RR, tel. 01327 310366.**

New nozzle reduces drift at high spray pressures

A new spray nozzle, the AI TeeJet from Spraying Systems Co., allows applicators to control drift when spraying at higher pressures.



Normally, pressure is the enemy of drift control. Increasing spray pressure decreases droplet size and mass, which increases drift. This creates a dilemma for spray applicators who need to spray at higher pressures.

"The new AI TeeJet is designed to overcome the pressure problem. It creates large, less drift-prone droplets even at pressures of 3 to 5 bar," says Dr Bernd Göbel, European Technical Director for Spraying Systems Co.

The AI TeeJet features a pre-orifice at the entrance of the nozzle where the spray liquid first enters. This pre-orifice, in combination with air induction through the suction holes, significantly increases droplet size through the large exit orifice.

"The barrel of the nozzle has two small openings. As the spray liquid passes by these openings at a certain velocity, it pulls air into the nozzle via a venturi. This added air, in combination with the pre-orifice, assists in creating larger droplets. In some cases, it can also help to improve coverage of the pesticide on the target crop," Göbel says.

"A spray applicator needs to select the right drift control nozzle for each application. The AI TeeJet is ideal for spraying all kinds of herbicides at pressures of 3 bar or more and liquid fertilisers such as UAN with 2 to 3 bar on pre-emergence; and for applying systemic insecticides and fungicides on heavy crop canopies at higher pressures for better penetration.

"At normal spray pressures of 1 to 3 bar, the patented Turbo TeeJet is the nozzle of choice because it creates very uniform, large droplets over the entire pressure range," Göbel continues. "For higher application rates - above 300 l/ha - at lower pressure, an extended flat fan nozzle such as the XR TeeJet is better suited for drift control as well."

Spraying Systems Co. markets a complete range of sprayer components under the TeeJet brand. In addition to spray tips, these include quick-attach nozzle bodies, solenoid and ball valves, spray guns, electronic controls and other products widely used in agriculture and horticulture.

Contact: **Martin Baxter at TeeJet Northwest Europe, Headley House, Headley Road, Grayshott, Hindhead, Surrey, GU26 6UH, tel. 01428-608888.**

Food and Agriculture Development Partnership launched

The newly-formed Food and Agriculture Development Partners (FADP) has brought together two of Europe's major specialist consulting groups. The partnership will offer an unrivalled international expertise in food and agricultural sector development and commercialisation. Although operating worldwide, FADP will initially focus on Central and Eastern Europe.

With 20 years experience in the pre-harvest consultancy sector, GFA-Agrar provides a natural complementarity to the Produce Studies Group's 40 years of marketing and postharvest experience.

Offering services to design, implement and manage development projects in the food and agricultural sectors, the FADP works for both public and private sector clients worldwide, including all of the major international funding agencies. All aspects of food chain development are comprehensively covered including input marketing, institutional development, credit, agricultural extension, agricultural marketing, product assembly, processing and distribution, market research and trade promotion.

Extensive in-house data management and research and consultancy programmes keep FADP at the forefront of the latest developments. A unique combination of leading-edge skills in problem solving is supported with appropriate technical and commercial expertise. Additionally, the Partners build upon an ongoing relationship of successful project implementation, based on extensive consultancy experience.

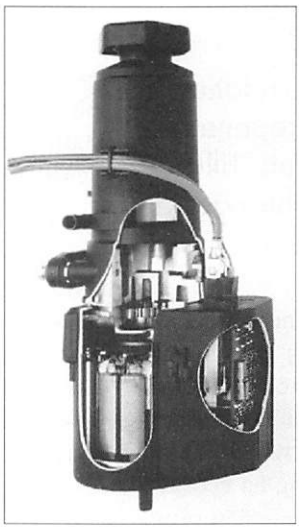
The Produce Studies Group is Europe's largest agricultural marketing consultancy. Through its worldwide network of subsidiary companies, it is uniquely placed to advise on, and assist with, marketing and commercialisation at all stages in the food chain. Areas of expertise include input supply management, production and processing through to distribution and retail. The Group has been a key player in the agricultural marketing restructuring process in Central and Eastern Europe and the Asian republics. Work has included the development of agricultural information systems, agricultural policy units and product marketing and processing, and food wholesaling and distribution.

The worldwide operating German consulting firm, GFA-Agrar, provides international consultancy services in agriculture, forestry and the food industry. Particular emphasis is placed on project planning, management, institutional development, farm advisory services and farm management. The company has played a major role in the agricultural restructuring process in Central and Eastern Europe. Work has included sector analyses, agricultural policy and input, and resource management.

Contact: **Prof. Peter Street, Produce Studies Group, Northcroft House, West Street,Newbury, Berks RG14 1HD, tel. 01635 46112.**

Versatile electro-hydraulic power pack

The new electro-hydraulic power pack introduced by Echlin Automotive Systems Ltd of Rochester, England, is an important new tool for designers of automotive, defence, agricultural, construction and marine equipment where hydraulic power or power-assisted steering and control are required. The compact, integrated pump/motor configuration uses a roller-vane, hydraulically-balanced, positive displacement pump and variable-speed 12 volt brushless DC motor incorporating a patented thermal management system and application-specific modular electronics. Software-controlled energy management reduces fuel consumption and exhaust emissions on vehicle applications.



Application-specific motor control

The Echlin power pack employs a variable-speed motor for low power consumption, a maximum of 920 watts. It has 4-phase windings with solid-state switching using 'Hall effect' commutation sensing. Modular electronics are used to provide application-specific motor speed control. The use of programmable software provides for the close control of a wide range of parameters.

The rotor is positioned around the stator and both the stator windings and power electronics are cooled by hydraulic oil which, together with the use of ferrite magnets, gives a high power-to-volume ratio.

Patented thermal management system

The patented thermal management system of the new power pack allows the unit to operate at high ambient conditions and is rated to 110°C with brief excursions to 130°C being possible. In the event of excessive heat, the whole unit is thermally protected and incorporates an overload capability; it will recover with full performance once the temperature falls. The stator windings are mounted on the aluminium pump body and the drive power switches are mounted on an aluminium heat sink fitted to the pump body. The thermal capacity of the system oil and of the pump components is utilised to dissipate the heat generated when operating at maximum power. The oil reservoir and filtration system are integral with the motor body.

On and off-road vehicles, agricultural and construction machinery, defence and marine applications

The use of proven pump and motor technologies together with solid-state electronics ensures long, reliable service life. For protection against corrosion, the motor and pump are housed in plastic injection mouldings. The integrated configuration of the new power pack gives it a compact design measuring only 135 mm x 95 mm x 325 mm; the low weight - only 3 kg - offers an outstanding power-to-weight ratio, and reduced complexity.

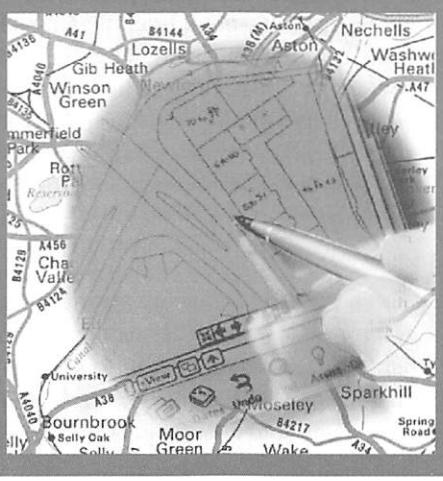
A CD describing the new electro-hydraulic power pack is available free of charge from Echlin Automotive Systems Ltd. Applications for the new unit range from the power-assisted steering of road vehicles to the control of agricultural implements via a tractor PTO as well as marine uses such as power trim and tilt on outboards, rudder control via an auto-pilot, and powering yacht winches. The new power pack's compact design, low weight and inherent reliability in the field will also make it attractive to designers of defence equipment.

Contact: **Echlin Automotive Systems Ltd, Priory Road, Strood, Rochester, Kent ME2 2BD, tel. 01634 304200.**

PocketGIS™ talks with 'CORPORATE GIS'

PocketGIS, the affordable field mapping and data capture tool running on the Newton MessagePad now benefits from an upgraded CONNECTION utility. CONNECTION, a 32 bit Windows application, provides the capability of exchanging map data between the Corporate GIS and PocketGIS in the field.

The new release of CONNECTION upgrades existing interfaces for ArcInfo, ArcView, MIF and UK OS, incorporating dynamic data dictionary construction to minimise GIS system administrator intervention. Additionally, it introduces Intergraph Microstation and various raster formats so that most popular GISs can now be supported.



With PocketGIS, existing GIS data can be made available to field teams for reference, verification and updating (red lining). New data which is captured can be uploaded via various media in an appropriate format ready for use with the users desktop or corporate GIS.

Unlike traditional disc based pentop solutions for field use, most of which have emerged from the specialised world of surveying, PocketGIS is low cost, weatherproof and robust. Simplicity of operation and software reliability make PocketGIS particularly suitable for use by multi skilled field teams.

Contact: **David Slorach, Positioning Resources Ltd, 64 Commerce St., Aberdeen AB11 5FP, tel. 01224 581502.**

Re-instating the last wilderness in Surrey

More than a decade of planned woodland clearance, rotational thinning and a scarification programme designed to regenerate heather growth has enabled Hankley Common Golf Club, Tilford, to restore the original lowland heathland nature of the course, described by English Nature as 'Surrey's last wilderness'.

In recognition of the Club's on-going commitment to conservation, Hankley Common won this year's Golf Environment Competition - jointly sponsored by BIGGA, Amazone Ltd and Rhone Poulenc Amenity - for which course manager Ian McMillan received, on behalf of the Club, a cheque for £5000 and the engraved bowl from BIGGA Chairman Pat Murphy.

Cutting and scarifying with an Amazone Groundkeeper flail collector was the most cost-effective and efficient method of creating the conditions suitable for the germination of the natural seed bank and early establishment of heather.

Two, equally important, reasons lay behind the decision, taken 12 years ago, to restore the area to its natural state: Surrey, with 13 per cent of the UK's lowland heath, has a critical role in the conservation of this very important landscape; and there was the desire to return the tree-dominated course to its original heathland design. "In golfing terms, a heathland course is an inland links: for the most part, an open landscape across which the wind blows," explained Ian McMillan.

The project involved the instigation of a vigorous tree felling programme and investigating ways of reinstating the heathland character, while developing an ecosystem keeping enough scrub to assist the diversity of wildlife present on the course. Natural regeneration through a process of scarification with an *Amazone Groundkeeper* flail collector - whose blade attachment system allows both knifes and scarifying flails to be fitted, together, on the same shackle ring - was a more cost effective and efficient method than burning or grazing.

Bob Taylor, Sports Turf and Research Institute ecologist, who assisted with the regeneration programme, explained: "The *Groundkeeper's* blades cut the above-ground litter, thatch and fibre, which is collected in the hopper, opening the area to air and light and exposing the underlying humus layer which is scoured by the scarifying flails to create the conditions suitable for the germination of the natural seed bank and early establishment of heather."

The *Groundkeeper* is also used to control mature areas of heather and to harvest seed which is used to seed reclaimed parts of the course, where necessary, and sold to other golf clubs providing a useful source of income to the Club.

"The clearance of some 40 hectares of trees, combined with rotational thinning and the scarification programme, has allowed the natural vegetation, harebell heather, common ling, gorse and heath grasses - to retum," said Ian McMillan.

"This has not only restored the heathland character of the area, but created a diversity of habitat for indigenous - and in some cases threatened - wildlife, including sand lizards, smooth snakes, adders, night jars, Dartford Warblers and the Silver Studded Blue Butterfly, the Club's sun dial."

Not all the woodland on the course has been removed, as it too has its place. "Trees should not be the dominant feature on a heathland course, but carefully retained they can act as strategic features and forin screens to break up the landscape," said Ian McMillan.

Contact: **Amazone Ltd, Rowse, Pillaton, Saltash, Cornwall PL12 6QU, tel. (01579) 351155.**

Contact: **Mr Chris Haywood, Marketing Manager, SKF Industrial Sales Division, Bradbourne Drive, Tilbrook, Milton Keynes MK7 8BJ, tel. 01908 838383.**

Shaping 3M's respirator revolution

Workers in Aerospace Composite Technologies have been taking part in a massive research programme devised by the Occupational Health Group of 3M in a bid to create a real breakthrough in respirator design. The programme, the most extensive ever undertaken by 3M, involved companies throughout Europe and has now resulted in the launch of a brand new type of respirator - the 9300 Series.

The 9300 Series features a great number of innovations, including a revolutionary three panel facepiece and new materials specially developed and patented by 3M, all of which increase the overall comfort of the device.

Comfort is vitally important in the field of Respiratory Protection Equipment (RPE). Extensive research has proven beyond doubt that the more comfortable a respirator feels, the more likely the worker is to wear it whenever necessary. As one of the world's leading manufacturers of RPE, 3M devotes considerable resources to improving its range of respirators in the bid to make them even more light weight, cooler to wear and easier to breathe through. Highly desirable attributes such as these are now offered by the new 9300 Series of respirators.

What makes the design so revolutionary?

The 9300 has a number of major advantages over other respirators.

- ***Cooler to wear***

  Three models incorporate a unique, highly efficient CPC valve which is located centrally in front of the nose and mouth. As a result, the build-up of heat and moisture is kept to an absolute minimum, and means that the device is cooler to wear than other respirators.

- ***Talking is easier***

  The three panel design allows for greater jaw movement, which makes talking far easier.

- ***Softer against the skin***

  In the 9300, the rigidity necessary to create a suitable breathing space comes from its internal structure instead of from the rim, as is the case in traditional cup-shaped designs. As a result, the material next to the skin can be soft, pliable and therefore extremely comfortable.

- ***More comfortable headband***

  The 9300's headband is made of a material which creates an even tension around the head. This prevents the development of any annoying pressure points.

- ***Easier to store***

  The three panel design can be easily folded and slipped into a pocket during rest periods, or replaced in its own packaging. This means the risk of contamination is minimised and the useful life of the device prolonged.

Developing the 9300 Series

Developing the 9300 involved focus panels and field trials conducted among hundreds of RPE wearers through Europe. Key industries and applications were selected so as to subject the 9300 to the most rigorous and varied test conditions possible. As well as Aerospace Composite Technologies, major participants included:

- one of Germany's biggest steel manufacturers;
- Aluchemie in Holland, producers of carbon anodes for the aluminium smelting industry;
- Dalmine, Italy's largest manufacturers of seamless steel tubes.

Focus panels were used to test the prototype 'blind' against the most popular respirators on the market. Feedback from the wearers was then used to refine the design further. The final design was tested in field trials conducted throughout Europe last autumn which generated extremely positive feedback.

Results

- Over **82%** of users said they preferred the 9300 to the respirator they were currently using.
- **90%** praised the way the 9300 minimise sweating and the build up of heat.
- Over **50%** said they had more confidence in the efficiency of the 9300.
- Approximately **66%** said they felt it made talking easier.
- Around **75%** said they preferred the size and fit, and that the 9300 felt better against the skin.
- The same proportion liked the individual, hygienic packaging.

Details of the range

The 9300 Series consists of five respirators, including three valved models. All are colour coded for easy selection, are CE marked, comply with EN 149 and supplied with individual, hygienic dispensers. The range consists of:

3M 9310 Dust Respirator offering FFP1S protection;

3M 9320 Dust/Mist Respirator offering FFP2S protection;

3M 9312 Valved Dust Respirator - for use in many general applications where heat and humidity are a problem and FFP1S protection is needed;

3M 9322 Valved Dust/Mist Respirator - delivers FFP2S protection in hot, humid environments;

3M 9332 Dust/ Mist/ Fume respirator - for most applications where high level protection to FFP3S against solids and waterbased mists is required.

Contact the **3M Health and Safety Helpline on 0800 212490 for free samples.**

Refrigerant gas analyser/identifier

Vehicle air conditioning specialists Vehicle Refrigeration Services (VRS), has a new answer to the problem of detecting contaminated refrigerants, in automotive air conditioning systems and gas cylinders, an automotive refrigerant gas analyser/identifier part number V8104.

This unique product identifies whether the R12 or R134a refrigerant is pure or is contaminated with another gas or air. It conforms to SAE standard J1771 and uses a four channel infrared sensor to analyse a small sample of the gas, it then informs the user, on a LCD display, the exact purity of the gas being tested.

Contaminated gas has become a vast problem in air conditioning systems, due to the recycling of refrigerants and the supply of 'so called' alternative refrigerants into the market, by some gas suppliers/manufacturers. Also, some engineers have found that new gas they bought has contained contamination.

The effect that contaminated gas can have on an air conditioning system can be vast and devastating. It could well lead to premature failure of the system and very expensive repairs. In fact, VRS's compressor rebuilding and repairing department has already seen very expensive compressors which almost certainly have been totally ruined by contaminated gas in a system.

If an engineer is unaware that a system they are working on contains contaminated gas, they will draw this into their recycling machine, thereby contaminating the pure gas in the machine. They will thereafter charge every vehicle with contaminated gas which then could well lead to a vast amount of very expensive warranty claims.

Until the 1st May 1998, VRS are offering their V8104 refrigerant gas analyser at a special introductory price of £750.00 +VAT, saving £125.00 off the normal trade price of £875.00. Should any vehicle owners wish to have the gas in their systems checked, to ensure the refrigerant is pure, VRS will also do this - free of charge - until 1st May, 1998 *(uncertain whether the vehicle is also included, Ed.).*

Contact: **Vehicle Refrigeration Services, VRS House, Shield Road, Ashford, Middlesex TW15 1AU, tel. 01784 248906.**

Compact new LandStar DGPS receiver launched by Racal

A smaller, lighter and more robust new LandStar DGPS receiver has been launched by Racal Survey to provide precise positioning for a wide range of land applications. LandStar receivers are already well established in a variety of activities where their reliability and positioning accuracy has earned them an enthusiastic following. The new Mk 4 model now introduces a range of additional benefits for users of LandStar in farming, aviation, GIS, data capture, survey and mapping applications.

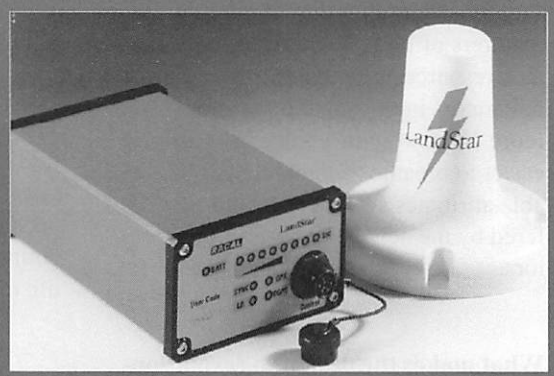
Substantially more compact than its predecessor, the LandStar Mk 4 consumes only 4 watts of power and makes bulky batteries unnecessary. For GIS and surveying applications, it is now possible to wear the complete LandStar system on a hip belt while still enjoying the benefits of sub-metre positioning accuracy when used with a survey grade 12 channel GPS receiver. With RTCM and NMEA outputs, the new unit is also available as an OEM board that can be integrated into other systems such as agricultural yield mapping systems.

Rugged durability is a major feature of the LandStar Mk 4's design. The new unit can be used in operating temperatures ranging from -35 deg C to +85 deg C and incorporates a high level of environmental shielding, including vibration protection to helicopter operation specifications. The new unit has a voltage input range of 9 V to 36 V and features a power surge regulator that overcomes the problems often encountered by such equipment in farming and aviation applications.

The LandStar service is available throughout Europe, North and South America, central southern Africa, the Middle East, Australia, New Zealand and Indonesia. The same LandStar receiver can be used in any of these regions. A network of reference stations provides differential corrections to GPS signals and these are relayed to LandStar users via powerful spot beam communications satellites. The corrections are transmitted in the L-band and are therefore resistant to interference and suitable for use in technically demanding situations such as those found in helicopters.

The strength of the satellite transmissions enables LandStar corrections to be received using a compact new combined GPS and LandStar antenna. The LandStar Mk 4 now also features an auto roaming capability that enables the unit to automatically select the nearest reference station. This ensures that the unit provides optimum performance without any action being necessary on the part of the user.

LandStar is operated by Racal Survey which was the first company in the world to operate a commercial differential GPS service and now has unrivalled experience in all aspects of the technology. Racal Survey is part of the Racal Electronics Group that has operations worldwide and an annual turnover of over £1 billion.



With a worldwide network of 23 business units, Racal Survey provides a complete range of integrated services including precise positioning services, geophysical and geotechnical surveys, unmanned vehicle (ROV) manufacture and operations, vessel and vehicle tracking and data management services. These are provided for land and offshore industries for oil and gas exploration and construction, telecommunications, surveying, mapping and agriculture.

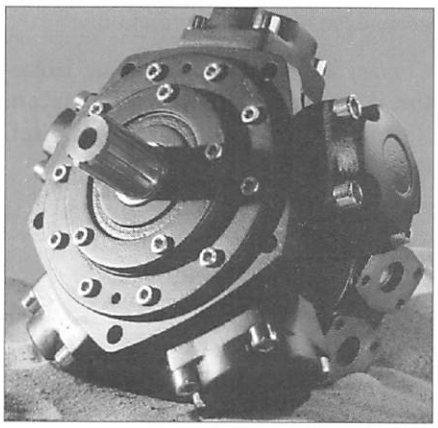
Visit Racal on the World Wide Web at http://www.racal.com.

Contact: **Paul Eastaugh, Racal Survey Ltd, Compass House, Davis Road, Chessington, Surrey KT9 IT13, tel. 01344 388062.**

Radial piston hydraulic motors; efficient, reliable & versatile

Berendsen Fluid Power have long been a distributor of Eaton Char Lynn gerotor and geroler type hydraulic motors, and to complement these Berendsen have introduced the Intermot range of high torque, low speed radial piston hydraulic motors. These motors offer improved start up and low speed running, have excellent volumetric efficiency, give a long trouble free service life and yet are surprisingly competitively priced.

Intermot motors are very versatile, they can be accurately matched to an application, there being 39 displacement steps in the range. They have removable cylinder liners so that the displacement of a motor can be changed by simply swapping liners and pistons; can be used in open or closed loop applications and



are reversible. Both keyed and splined shaft options are available.

The long service life of Intermot motors is attributable to the use of large tapered roller shaft bearings (which also permit high radial and axial loads), and the large volume of the case. The large quantity of oil contained in the case provides excellent lubrication and cooling of the motor.

High volumetric efficiency is achieved through the use of teflon piston seals and a patented distributor valve mechanism which also reduces the overall noise level.

The Intermot range covers displacements from 113 to 5383 cm^3/rev, specific torque from 1.8 to 85.5 bar and power from 38 to 209 kW. The maximum pressure capability varies by capacity and frame size, the maximum being 250 bar continuous, 300 bar intermittent and 420 bar peak. The maximum shaft speed varies from 950 rpm for the smallest unit to 100 rpm for the largest.

Contact: **Paul Hensman, Berendsen Fluid Power Ltd, Sandy Way, Amington Industrial Estate, Tamworth, Staffordshire B77 4DS, tel. 01827 69369.**

Lucas/CAV spring starter lives on

The well known Lucas/CAV/Simms mechanical spring starter will now be marketed throughout the UK and Europe by IPU START. The deal marking this exciting development was concluded in London prior to the Europort show between Kineteco and IPU. This is a significant move forward for all manufacturers who want to offer the option of emergency start systems on engines under 9 litres.

IPU START are well known for their international ability to solve Air and Hydraulic starting problems for virtually any engine. The recent addition of the only Lloyds Register approved Spring Starter to their range is seen as a great coup.

IPU's connection with the Spring Starter goes back several years. When Lucas/CAV lost interest in the product, IPU tried to secure supplies. However, Lucas would not release their patents and approvals. A search for an alternative spring starter was unsuccessful; no other was made with Lloyds Approval which is vital to manufacturers supplying the marine or offshore industry. Finally, Kineteco who had bought all Lucas drawings, stock and patents in 1996, approached IPU to revive the product.

Kineteco talked to customers around the world about what they wanted from a spring starter and several modifications have been incorporated into the latest product as a result of their research. Both IPU and Kineteco will be developing the number of engines to which the starter can be fitted. IPU START's immediate plans are to develop new customers for the product. The company is also looking at developing the product to start both smaller and larger engines with reliable competitively priced products.

The Spring Starter takes 12 winds of the handle to store up to 125 Nm torque in compressed belville washers. It is currently available in several formats to suit a wide variety of needs. These are flameproofed, marinised, generator spec or Lloyds Register approved.

Industrial Power Units Ltd of Wolverhampton, England, have over 25 years experience in the starting market, covering all related applications - from mining to offshore applications. IPU aims to provide a total solution for starting needs, from consultation through design to commissioning.

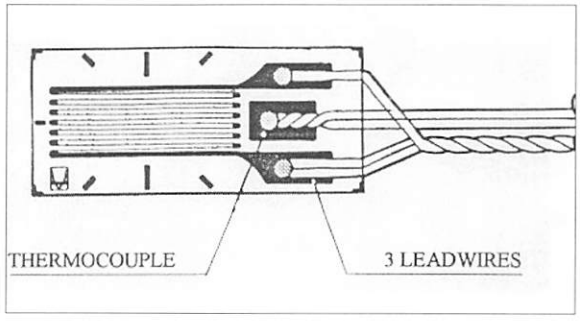
Contact: **David Caddick, IPU Ltd, Sutherland Avenue Wolverhampton WV2 2RA, tel. 1902 452138.**

Strain gauge - thermocouple sensor

The New Kyowa dual element sensor type KFGT combines a linear strain gauge and a type 'T' thermocouple within a common base. This offers several possible advantages during temperature critical testing between 0°C and + 100°C.

If an accurate test temperature at the strain gauge location can be monitored simultaneously to that of the strain gauge, then any apparent strain, and gauge factor variation, caused by temperature changes could be corrected by referring to self temperature compensation, and gauge factor - temperature data for that particular strain gauge. Another application advantage could be the reduction in installation time for multi-point measurements where both strain and local temperatures need to be monitored. The 120 ohms gauge is supplied with a 3 wire twisted 1 metre lead, and 1 metre thermocouple lead as standard.

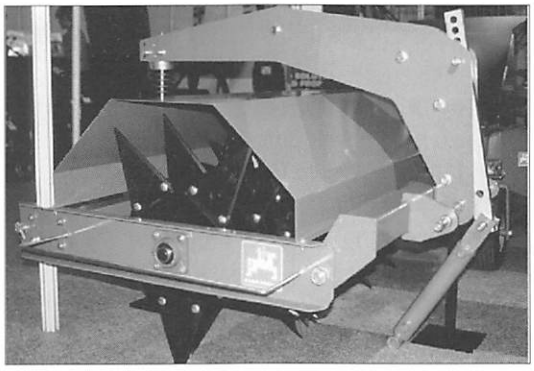
Contact: **Jeffrey Beck, Graham & White Instruments Ltd 135 Hatfield Road, St Albans. AL1 4LZ, tel. 01727 863278.**



Amazone unveils pre-production slitter/aerators

Amazone Ground Care unveil pre-production models of two of its new four-model range of slitter/aerators. They incorporate a unique blade configuration that ensures high point pressure across the full width of the implement at high operating speeds, while exerting 91 kg/point pressure for entry into the thickest thatch.

Designated the Amazone SL, SLC and SLS series, all are three-point linkage mounted and will be available in working widths of 1.2 metres and 2.4 metres. SLS models also feature a new contour following system.



Pre-production SLS slitter/aerator, with side panels removed for illustration. Contour following comes from the inter-action between the front hydraulic depth control ram and the rear-mounted, pre-loaded spring.]

The SL forms the base of the new range and is intended for working on flat ground. Its fully enclosed 1.2 m-wide ground-driven rotor is fitted with 40 blades, each of which, uniquely, is mounted with a 10 degree offset. With that pattern, all the points in contact with the surface penetrate the ground to an equal depth when the slitter is driven forward - so eliminating the 'walking' effect associated with some blade layouts - and ensuring the implement remains level at high forward speeds. A solid bar supports the rear of the implement and depth of penetration, up to 12 cm, is set by means of a hydraulic ram.

Two 1.2 m rotors are joined to form the 2.4 m-wide SLC model, which also features contour following through a floating chain and bar support at the rear of the implement. Penetration depth on this model is by means of weights around the rotor axle.

At the top of the new slitter range is the 1.2 m-wide SLS. This model also features a new contour following mechanism, comprising a front-mounted hydraulic depth ram connected through an arm to a pre-loaded spring anchored to the frame at the rear of the implement. When crossing an undulation, the operating depth is maintained through ram pressure, while the spring releases to enable the tractor's rear wheels to remain on the ground, so maintaining traction.

Contact: **Rod Baker, Managing Director, Amazone Ltd, Rowse, Pillaton, Saltash, Cornwall PL12 6QU, tel. 01579 351155.**

Volvo Penta diesels sweeten sugar beet harvesting

Volvo Penta industrial mobile TWD 1031 VE diesel engines are assisting in the development of some of the world's most efficient agricultural machinery, including sugar beet harvesters from German specialist manufacturer Franz Kleine.

The Kleine company has a reputation for innovation. Its SF10 machine, for example, is a new concept in sugar beet harvesting, delivering the topped and lifted roots directly into trailers running alongside and, if required, holding up to 15 m^3 in an integral bunker until an offloading facility is available. In this way, the machine can harvest a quarter of a hectare without the need for a trailer, ensuring continuous operation while attendant trailers discharge their loads. With its 1.4 metre discharge elevator, the SF10 can also discharge directly onto clamps or into lorries, if required.

Topping and lifting is carried out in front of the harvester before the wheels have passed between the rows of sugar beet. Steel flails and scalpers top the beet before oscillating shares lift them. A five turbine cleaning system delivers the crop to the bunker in an undamaged state.

Kleine's SF10 is powered by a Volvo Penta emission controlled TWD 1030 VE diesel, a 9.6 litre, 212 kW turbocharged and fluid/air intercooled engine which has proved itself in countless installations throughout the world. In common with all Volvo Penta diesels, its six cylinder, direct injection layout is among the most fuel efficient and reliable currently available.

In the Kleine SF40, a prototype harvester under development, a mighty 16 litre Volvo Penta TWD 163OV turbocharged diesel with fluid/air intercooling provides power for a machine which is expected to revolutionise sugar beet harvesting. As the largest diesel engine in the range, it develops 383 kW and a peak torque of 2050 Nm.

Contact: **Volvo Penta Europe, Otterspool Way, Watford, Herts WD2 8HW, tel. 01923 228544.**

Teagle buy 3 m and 4 m CNC pressbrakes for bigger farms and smaller stocks

Agricultural engineers, Teagle Machinery Ltd have installed 3 m and 4 m bed length Edwards Pearson CNC hydraulic pressbrakes at their Blackwater, Truro, works, to produce bigger machines for larger farms and to cut stock levels through more efficient batch manufacture.

Established in 1943 in response to the wartime/postwar demand for increased agricultural productivity to replace imported food, Teagle today employ around 100 people, making tractor-mounted and trailed machinery. They export about 25% of production to markets as diverse as Europe, North America, Japan and Korea.

By the extensive use of fabricated pressings and tubular sections, optimised through computer aided design techniques, Teagle have developed a wide range of modern machines which are strong, light and easily maintained. They include 'TD50' universal broadcasters, which spread fertiliser in a strip up to 24 m wide; pasture toppers, akin to agricultural-scale lawnmowers; 'Super-ted' high speed swath conditioners, which turn and aerate cut grass and straw; 'Tomahawk' 'Quick Hitch' A-frames, for simple and convenient coupling of implements and trailers to tractors.

"In a typical year, we make around 2700 machines of many different types, and 'call-offs' for each variant tend to be in small numbers," explains Managing Director Fred Teagle. "Using conventional folding machines, changing between jobs was such a long-winded business that it was easier to produce components in long runs, but that meant tying up a lot of capital in stock. We recognised that switching to CNC pressbrakes would allow us to manufacture parts in small batches - say, a week's requirement of 25 or 30 at a time - but still keep unit cost down.

"Also, as more and more farms are amalgamated there's a demand which we're happy to satisfy for ever-larger machines," continues Fred. "So it made sense to buy at least one machine that could cope with components up to 4 m long, when necessary."

Teagle Machinery have bought two, 100 tonne Edwards Pearson pressbrakes in successive years: an RT4 with 4100 mm bed length and a 3100 mm PR4. "We chose Edwards because their works at Chard, in Somerset, are only 140 miles away if we ever need help and because they were able to meet our technical spec at a very competitive price, including trade-in allowances," says Fred.

Teagle Machinery's Super Ted swath conditioner built with the help of Edwards Pearson's CNC pressbrakes.

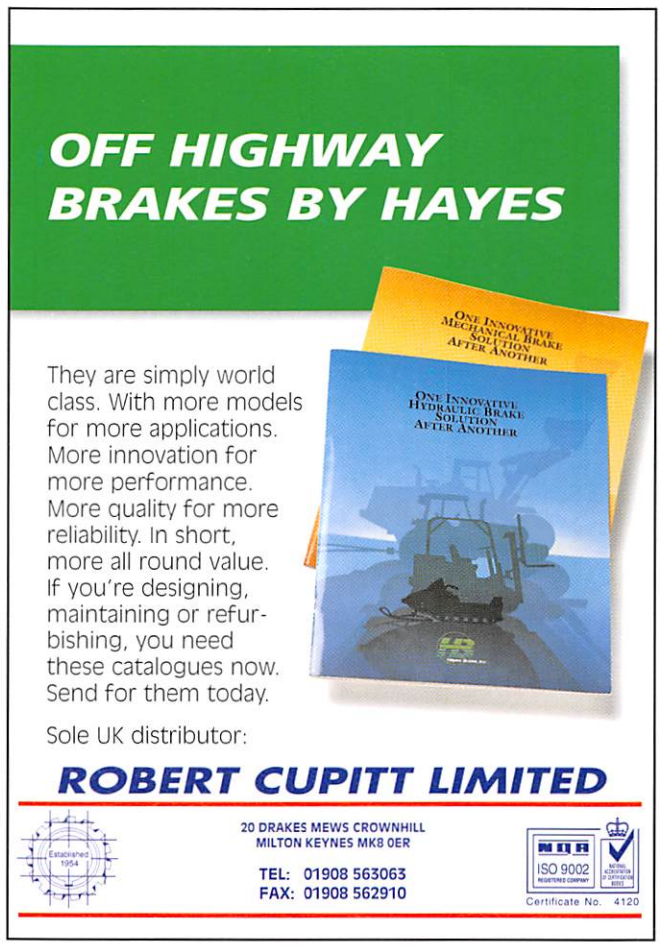
Two generations of the same basic dowm stroking design, the RT and PR range incorporate the patented 'pressure reference' control system, which monitors actual pressures generated within the hydraulic circuits and automatically compensates for both beam and sideframe deflection. This gives much more precise control of the beam's position throughout the stroke and under load, enabling components of varying lengths to be formed without adjustment, correction or trial bends, at operating speeds up to twice those of conventional pressbrakes.

Both machines have Cybelec DNC 70 two dimensional graphic systems which control all bending functions, including blank length development calculation. A high precision CNC-controlled twin leadscrew 500 mm backgauge system controls the X and R axes, with an independent Z_1 and Z_2 facility. The flip-up backgauge heads have second stops to give 850 mm gauging length. Two, 300 mm front support arms are fitted.

Installed in a sheet metalworking cell, the pressbrakes exclusively work mild steel, in thicknesses from 2.5 mm to 8 mm.

"Our operators create programs directly on the machine controls and store them in memory for future re-use," says Fred. "An incidental advantage, which is obvious when you think about it, is that new programs are generated as an intrinsic part of the product development process, so that they're immediately available for production use when a new design is finalised and sold!"

Contact: **Edwards Pearson Limited, Chard, Somerset TA20 2AB, tel. 01460 65441.**



Institution of Agricultural Engineers

National Conference • AGM Annual Luncheon • Awards Ceremony

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Ambassador Bo Kjellen
Ministry of the Environment, Stockholm, Sweden

Dr Michael Kelly
Building Design Unit, Scottish Agricultural College
Past Chairman, Rural Design and Building Association

Prof. Francis Sevila
University of Montpelier, France
Past President, European Society of Agricultural Engineers

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